DRAFT

PROPOSED SURFACE WATER INTERIM MEASURES/ INTERIM REMEDIAL ACTION PLAN/ ENVIRONMENTAL ASSESSMENT AND DECISION DOCUMENT

WOMAN CREEK BASIN

OPERABLE UNIT NO. 2

U.S. DEPARTMENT OF ENERGY

Rocky Flats Plant
Golden, Colorado

ENVIRONMENTAL RESTORATION PROGRAM

02 October 1991

Volume I - Text

SURFACE WATER INTERIM MEASURES/INTERIM REMEDIAL ACTION PLAN/

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VOLUME I

U.S. Department of Energy
Rocky Flats Plant
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02 OCTOBER 1991

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NOTICES TO THE READER

General

This Draft Proposed Surface Water Interim Measures/Interim Remedial Action Plan/Environmental Assessment (IM/IRAP/EA) and Decision Document for Woman Creek Basin dated 02 October 1991 is identical to the draft Proposed IM/IRAP/EA dated 04 September 1991. The reader will note that the text within this document retains the "September 1991" date. The cover and title page of this document, however, displays an 02 October 1991 date merely to reflect the Inter-agency Agreement milestone schedule date for submission of the draft Plan to the U.S. Environmental Protection Agency (EPA) and the Colorado Department of Health (CDH).

Environmental Data

The analytical data presented in the Woman Creek Basin IM/IRAP/EA was obtained from the Rocky Flats Environmental Database System (RFEDS). The data often include qualifiers to aid the reader in assessment of the contaminant concentrations reported. These qualifiers are defined in many of the data tables presented in the appendices (i.e. Volume II) of this document. The four most common data qualifiers are briefly discussed here for the benefit of the reader.

U = Not detected. The sample was analyzed for the chemical in question, but was not detected. The result is reported as the numerical value of the method detection limit followed by an upper case "U" (e.g., 5U parts per billion).

J = Present below detection limit. Laboratory analysis indicates the chemical in question is present in the sample, but at a level below the method detection limit. In this case, the concentration of the chemical can only be estimated. The accuracy of concentration estimates that are below the method detection limit vary from analysis to analysis. The estimated value is reported with an upper case "J" (e.g., 2J parts per billion).

E = Estimated. Laboratory analysis indicates that the contaminant concentration is above the detection limit, but its value can only be estimated due to instrument signal interference (i.e., the presence of other chemicals) and/or the concentration is above the upper range of calibration of the instrument. The accuracy of concentration measurements that are "Estimeated" vary from analysis to analysis. Estimated results are reported as the numerical value followed by the upper case "E" (e.g., 70E parts per billion).

B = Present in blank. As part of the laboratory Quality Assurance/Quality Control Program, sealed samples of distilled water accompany environmental samples as they are handled within the analytical laboratory. The distilled water samples are called laboratory blanks and are analyzed along with the environmental samples. The purpose of blank analysis is to reveal contamination of the associated environmental samples with chemicals used in the laboratory. Blank analysis often indicates the presence of volatile organic compounds commonly used as laboratory solvents (e.g., acetone and methylene chloride). When analysis of a laboratory blank associated with an environmental sample reveals the presence of a chemical, the concentration of that chemical in the environmental sample is reported with an upper case "B" (e.g., 20B parts per billion).

NOTICES TO THE READER (continued)

The method detection limit for a chemical is specific to the sample analysis performed and is a function of the analysis method, instrument detection limit, and sample dilution factor. As a result, the method detection limit reported for a given chemical may vary from analysis to analysis. For example, non-detect analyses for trichloroethylene may be reported as 5U and 20U for two separate analyses.

Tables 2-2 and 2-3

Contaminant concentration means and standard deviations presented in Tables 2-2 and 2-3 consider non-detect data values. The statistical calculations use one-half of the reported detection limit for each non-detect datum. Note that for a data set including one or more non-detects, the computed average contaminant concentration may be less than the reported detection limits for that constituent.

Table 4-2

The Pond C2 contaminant concentrations listed in Table 4-2 are computed average values. As discussed above, the calculation of an average concentration for a data set including non-detects uses one-half of the reported detection limit for each non-detect datum. For constituents having at least one detect datum for Pond C2, the average concentrations are computed and listed in the column entitled "Pond C2". For constituents having all non-detect data for Pond C2, "ND" is listed in the column entitled "Pond C2." Raw contaminant data used in computing average Pond C2 concentrations is presented in Appendix B.

Contaminant background values listed in Table 4-2 were obtained from the "Background Geochemical Characterization Report" prepared by EG&G - Rocky Flats, Inc. (21 December 1990).

The following footnotes were mistakenly omitted from Table 4-2 in the 02 October 1991 draft: "NS = No Standard" and "ND = Not Detected."

APPENDIX A

The concentration units of the radionuclide and volatile organic compound data presented in Appendix A are picoCuries per liter (pCi/ℓ) and micrograms per liter ($\mu g/\ell$), respectively. Each radionuclide concentration datum reported in Appendix A is followed by the associated measurement error (e.g., 0.22/0.03 is 0.22 ± 0.03 pCi/ℓ). The error term is the uncertainly introduced into the measurement by radiation counting instrumentation.

The ground-water and surface water data tables presented in Appendix A and Appendix B-1 (first table) summarize radionuclide and volatile organic compound data. For purposes of these summary tables, a "-" symbol is used to indicate a non-detect. The traditional "U" designation indicating the method detection limit is not used for reasons of clarity. A definition of "U" was mistakenly included in the footnotes of these tables.

EXECUTIVE SUMMARY

Water quality investigations have identified the presence of volatile organic compounds (VOCs) and radionuclide contamination in surface water at the Rocky Flats Plant (RFP). The subject Interim Measures/Interim Remedial Action Plan/Environmental Assessment (IM/IRAP/EA) addresses contaminated surface water seeps in a portion of the Woman Creek drainage basin located within an area identified as Operable Unit No. 2 (OU 2). OU 2 is defined in the Environmental Restoration Federal Facility Agreement and Consent Order (commonly known as the "Inter-Agency Agreement" or IAG), and is comprised of several Individual Hazardous Substance Sites (IHSSs) that are known in aggregate as the 903 Pad, Mound, and East Trenches Area. Various IM/IRA alternatives for the collection and treatment of the seepage are identified and evaluated along with an assessment of the No Action Alternative.

Because there is no immediate threat to public health and the environment posed by this surface water contamination, and the seeps are not exacerbating environmental contamination, the No Action Alternative has been determined to be the preferred alternative. Remediation of contaminated seepage will await the final remedial action for OU 2, scheduled (as required by the FFACO) to be completed within 7 years, without threatening public health or the environment. This decision is in accordance with the U.S. Environmental Protection Agency's (EPA) Office of Solid Waste and Emergency Response (OSWER) Directive 9355.0-30 which states that an interim remedial action should be based on the presence of contamination which, if left unaddressed in the short term, either contributes immediate risk or is likely to contribute to increased site risk or degradation of the environment/natural resources. These conditions do not exist for the Woman Creek Basin seeps. Also, the OSWER Directive states that, in cases where the cumulative carcinogenic site risk to an individual based on reasonable maximum exposure is less than 10^{-4}, the non-carcinogenic hazard index (HI) is less than 1 and there are no adverse environment impacts, remedial action is generally not warranted. Calculations, assuming an unlikely and highly conservative exposure scenario, indicate public health risks resulting from the seeps is significantly less than 10^{-4}, or 1 in the case of HI. Actual public health risks are not significant and approach zero. Also, there are no adverse environmental impacts resulting from the seeps.

In February and March 1990, representatives from the U.S. Department of Energy (DOE), EPA, and the Colorado Department of Health (CDH) met to discuss surface water IM/IRAs at the RFP site. The result of these meetings was a series of agreements, with the concurrence of all parties, to implement an IM/IRA for the cleanup of contaminated surface water in OU 2. On 26 September 1990, the DOE released for public comment a proposed Surface Water IM/IRA Plan and Decision Document for OU 2. In this Plan, specific point source locations in the South Walnut Creek and Woman Creek drainage basins were proposed for collection of surface water. According to the Plan, surface water collected in each basin was to be transferred to a treatment facility discharging to the South Walnut Creek drainage. Effluent would ultimately flow to Pond B-5, where water is monitored, treated as necessary, and discharged in accordance with the Plant's National

Pollutant Discharge Elimination System (NPDES) permit. Comments on the IM/IRAP received during the public comment period, however, revealed strong opposition to the transfer of radionuclide-contaminated seep water from the Woman Creek drainage to the South Walnut Creek drainage. Opposition was based on the absence of a proven performance record for the proposed IM/IRA treatment facility with respect to radionuclide removal, and the potential for treatment process upsets. In addition, the public voiced strong concern over potential worker and public health risks resulting from construction activities in the Woman Creek Basin (i.e., atmospheric suspension of radionuclide-contaminated dust). In light of these concerns, the DOE and regulatory agencies agreed to eliminate the proposed interbasin transfer of surface water within this IM/IRAP, and to address collection and treatment Woman Creek seepage under a separate IM/IRAP that included IM/IRA alternatives that did not require interbasin transfer of Woman Creek surface water (IM/IRA Alternative No. 4 satisfies this commitment). Further, EPA mandated that treatability studies of various treatment technologies were to be conducted in the Spring of 1991 to provide performance data for radionuclide removal. However, seep flows were insufficient for collection of an adequate volume with sufficient levels of radionuclides for conduct of these studies. As subsequently discussed with EPA and CDH, it was agreed that the Woman Creek Basin IM/IRAP/EA would be prepared in the absence of such studies to avoid project delays. However, this IM/IRAP/EA demonstrates that no further action is required for the Woman Creek Basin seeps at this time. In contrast, the South Walnut Creek Basin IM/IRA is being implemented and may prove to significantly reduce or eliminate VOCs in the downstream detention pond, Pond B-5.

After presenting the general extent of the contamination within OU 2 and the specific environmental issues associated with the Woman Creek Basin seeps, this plan subsequently presents an assessment of the No Action Alternative and evaluations of four surface water collection and treatment alternatives with respect to effectiveness, implementability, environmental impact, and cost. All of the alternatives include a common method for surface water collection: surface diversion and collection at the sources. In addition, all alternatives rely, in part, on either existing or planned RFP processes for treatment of Woman Creek Basin seep water.

IM/IRA Alternative No. 1 involves treatment of seep water to remove volatile organic compounds (VOCs) with the granular activated carbon (GAC) adsorption system planned for installation near Building 231B. Treatment at the Building 231B GAC Adsorption System is followed by treatment with the Building 374 Low-Level Wastewater Treatment System for removal of radionuclide and metal contaminants.

IM/IRA Alternative No. 2 includes use of the South Walnut Creek Basin IM/IRA Chemical Precipitation/Microfiltration and GAC Adsorption System as was proposed in the 26 September 1990 Surface Water IM/IRA/EA for OU 2. Public concerns over lack of a process performance record in removing radionuclides from surface water is addressed in Alternative No. 2 by initially treating Woman Creek Basin seep water in batches separate from South Walnut Creek Basin surface water influent. The batch-treated water will be collected and discharged into the Woman Creek Basin. Upon verification of process performance, Woman and South Walnut Creek Basin surface waters will be commingled, treated, and discharged into the South Walnut Creek drainage.

IM/IRA Alternative No. 3 involves construction of a new air stripping system to remove VOCs from Woman Creek Basin seep water. The effluent from the air stripping system is then treated with the Solar Pond Evaporation System that is currently being installed in Building 910. Effluent from the evaporation system will be recycled to the RFP process water supply. A small, concentrated "brine" stream containing radionuclide and metal contaminants will also be generated. This waste brine will be subsequently stabilized by cementation.

IM/IRA Alternative No. 4 proposes construction of a new chemical precipitation and filtration system to remove suspended solids, and thus, particulate radionuclide and metals contamination from Woman Creek Basin seep water. The filtered effluent is then processed by the 881 Hillside Ground-Water Treatment System that is currently being installed in Building 891 as part of the OU 1 Ground-Water IM/IRA. Effluent discharged would be to the South Interceptor Ditch (SID) and flow to Pond C-2.

Selection of the No Action Alternative is based on an absence of significant public health risks or continued environmental degradation resulting from the Woman Creek Basin seeps. For example, a conservative estimate of cumulative carcinogenic risk from inhalation of VOCs emerging from the seeps and transported to the RFP boundary is less than 10^{-9}. This risk is well below 10^{-4}, the risk used by the EPA to establish a need for remedial action. Likewise, the hazard index (HI) resulting from inhalation of seep-related VOCs is conservatively estimated at less then 10^{-6}, well below the remedial action criterion of 1. An HI value less than 1 implies that adverse, non-carcinogenic effects are not expected.

Public consumption of water discharged from Pond C-2 is also examined as a second potential exposure pathway. The model assumes the unlikely scenario that all of the radionuclide and VOC contamination in Pond C-2 has resulted from the Woman Creek Basin seeps. Cumulative carcinogenic and risks and the HI are estimated at less than $3x10^{-6}$ and less than 0.02, respectively.

The low potential for increased environmental degradation due to the seeps was demonstrated by examination of Woman Creek Basin surface water, ground-water, and soil contaminant data. These data suggest that the source of plutonium in the surface water is from the 903 Pad and Lip Area soils (i.e., plutonium-contaminated suspended solids) rather than ground-water seepage. Also, downgradient transport of plutonium-contaminated soils, if occurring, would be confined within an area of significant surface soil plutonium contamination because the seeps appear to extend on the ground surface only short distances downgradient of their sources prior to re-infiltration and/or evaporation. Lastly, the Woman Creek Basin seeps do not appear to be resulting in downgradient contamination of the ground water. This is supported by the historical presence of VOCs in ground water throughout this immediate area, and the complete absence of plutonium in a ground-water well located downgradient of the Woman Creek Basin seeps near the SID.

SURFACE WATER INTERIM MEASURES/INTERIM REMEDIAL ACTION PLAN/ ENVIRONMENTAL ASSESSMENT AND DECISION DOCUMENT WOMAN CREEK BASIN AT OPERABLE UNIT NO. 2

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GLOSSARY OF ACRONYMS

ACRONYM	MEANING
ACL	Alternate Concentration Limit
Am	Americium
ARAR	Applicable or Relevant and Appropriate Requirement
AWQC	Ambient Water Quality Criteria
BAT	Best Available Technology
BDAT	Best Demonstrated Available Technology
BDL	Below Detection Limits
CAA	Clean Air Act
CCl_4	Carbon Tetrachloride
CCR	Colorado Code of Regulations
CDH	Colorado Department of Health
CDI	Chronic Daily Intake
CEARP	Comprehensive Environmental Assessment and Response Program
CEDE	Committed Effective Dose Equivalent
CEQ	Council of Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
$CHCl_3$	Chloroform
Ci/m^3	Curies per cubic meter
Ci/s	Curies per second
CIRC	Chronic Inhalation Reference Concentration
cm/s	Centimes per second
CMS/FS	Corrective Measures Study/Feasibility Study
COE	U.S. Army Corps of Engineers
CRDL	Contract Required Detection Limit
CRP	Community Relations Plan
CS	Collection System (for Surface Water)
CWA	Clean Water Act
d/m/g	Disintegrations per Minute per Gram
DOE	Department of Energy
DOT	Department of Transportation
DRCOG	Denver Regional Council of Governments
E	Emissions
EA	Environmental Assessment
EDE	Effective Dose Equivalent
EE/CA	Engineering Evaluation/Cost Analysis
EIS	Environmental Impact Statement
EM	Environmental Management Program
EO	Executive Order
EP	Extraction Procedure

EPA	Environmental Protection Agency
ERHSPP	Environmental Restoration Health and Safety Program Plan
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FEIS	Final Environmental Impact Statement
FFACO	Federal Facility Agreement and Consent Order (otherwise known as the Inter-Agency Agreement, IAG)
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FRP	Fiberglass Reinforced Plastic
FS	Feasibility Study
FWCA	Fish and Wildlife Coordination Act
FWS	Fish and Wildlife Service
ft/ft	Feet Per Feet
ft/yr	Feet Per Year
GAC	Granular Activated Carbon
$gal/ft^2/d$	Gallons Per Square Foot Per Day
GOCO	Government Owned, Contractor Operated
gpd	Gallons Per Day
gpm	Gallons Per Minute
GPM/ft^2	Gallons Per Minute Per Square Foot
HEC	Health Effects Criterion
HI	Hazard Index
HS	Health and Safety
HS&E	Health, Safety and Environment
HSL	Hazardous Substance List
HSU	Hydrostratigraphic Unit
HSWA	Hazardous and Solid Waste Amendments of 1984
H_2O_2	Hydrogen Peroxide
HQ	Hazard Quotient
IAG	Inter-Agency Agreement - the Federal Facility Agreement & Consent Order (FFACO)
IDL	Instrument Detection Limit
IHSS	Individual Hazardous Substance Site
IM/IRAP/EA	Interim Measures/Interim Remedial Action Plan/Environmental Assessment
IRIS	Integrated Risk Information System
kg/s	Kilogram per second
kw	Kilowatt
KW-HR	Kilowatt-Hour
LCF	Latent Cancer Fatality
LDR	Land Disposal Restrictions
M	Molarity
m/s	Meter per Second
m^3/s	meter cubed per second
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
mCi/m^2	milli curie per square meter
MDA	Minimum Detectable Activity

GLOSSARY OF ACRONYMS (Continued)

mg/kg	Milligrams Per Kilogram
mg/ℓ	Milligrams Per Liter
mg/m^3	milligram per cubic meter
mg/s	milligram per second
mph	Miles per Hour
mrem	milli radiation equivalent man
NCP	National Contingency Plan
NEMA	National Electrical Manufacturer's Association
NEPA	National Environmental Policy Act of 1969
NPDES	National Pollutant Discharge Elimination System
ORP	Oxidation Reduction Potential
OSA	Operational Safety Analysis
OSWER	Office of Solid Waste and Emergency Response
OU 2	Operable Unit No. 2
PA	Protected Area
PCE	Tetrachloroethene
pCi/g	picoCuries per Gram
pCi/kg	picoCuries per Kilogram
pCi/ℓ	picoCuries per Liter
PEL	Permissible Exposure Limits
PL	Public Law
POTW	Publicly Owned Treatment Works
ppb	Parts Per Billion
PPCD	Plan for Prevention of Contaminant Dispersion
PPE	Personal Protective Equipment
ppm	Parts Per Million
PSI	Pounds Per Square Inch
Pu	Plutonium
PWF	Present Worth Factor
QA/QC	Quality Assurance/Quality Control
RAAMP	Radioactive Ambient Air Monitoring Program
RCRA	Resource Conservation and Recovery Act of 1976
RfD	Reference Dose
RFI/RIFS	RCRA Facility Investigation/Remedial Investigation Feasibility Study
RFP	Rocky Flats Plant
RI	Remedial Investigation
RSO	Responsible Supervisory Official
SARA	Superfund Amendments and Reauthorization Act of 1986
SCFM	Standard Cubic Feet Per Minute
SDWA	Safe Drinking Water Act
SED	South Interceptor Ditch
SID	South Interceptor Ditch
SOP	Standard Operating Procedure

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GLOSSARY OF ACRONYMS (Continued)

SSHSP	Site-Specific Health and Safety Plan
SW	Surface Water Monitoring Station
SWMU	Solid Waste Management Unit
TBC	To Be Considered
TCE	Trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TOSCO	The Oil Shale Company
TSCA	Toxic Substances Control Act
U	Uranium
UMTRA	Uranium Mill Tailings Remedial Action
USFWS	United States Fish and Wildlife Service
UV	Ultraviolet
VOC	Volatile Organic Compound
WQCC	Colorado Water Quality Control Commission
X/Q	Average Dispersion Coefficient
μ	Micro
$\mu Ci/m^2$	MicroCuries per Square Meter
$\mu Ci/\ell$	Microcuries Per Liter
$\mu g/\ell$	Micrograms Per Liter
$\mu g/kg$	Micrograms Per Kilogram
1,1-DCA	1,1-dichloroethane
1,2-DCA	1,2-dichloroethane
1,1-DCE	1,1-dichloroethene
1,2-DCE	1,2-dichloroethene
1,1,1-TCA	1,1,1-trichloroethane
1,1,2-TCA	1,1,2-trichloroethane

SECTION 1

INTRODUCTION

Water quality investigations have identified the presence of volatile organic compounds (VOCs) and radionuclide contamination in surface water at the Rocky Flats Plant (RFP). The subject Interim Measures/Interim Remedial Action Plan/Environmental Assessment (IM/IRAP/EA) addresses contaminated surface water in a portion of the Woman Creek drainage basin located within an area identified as Operable Unit No. 2 (OU 2). Various IM/IRA alternatives for the collection and treatment of the seepage are identified and evaluated along with an assessment of the No Action Alternative. OU 2 is defined in the final Environmental Restoration Federal Facility Agreement and Consent Order (FFACO) (DOE, 1991), commonly known as the Inter-Agency Agreement (IAG), and is comprised of several Individual Hazardous Substance Sites (IHSSs) that are known in aggregate as the 903 Pad, Mound, and East Trenches Areas.

Because there is no immediate threat to public health and the environment posed by this surface water contamination, and the seeps are not exacerbating environmental contamination, the No Action Alternative has been determined to be the preferred alternative. Remediation of contaminated seepage will await the final remedial action for OU 2, scheduled (as required by the FFACO) to be completed within 7 years, without threatening public health or the environment. This decision is in accordance with the U.S. Environmental Protection Agency's (EPA) Office of Solid Waste and Emergency Response (OSWER) Directive 9355.0-30 which states that an interim remedial action should be based on the presence of contamination which, if left unaddressed in the short term, either contributes immediate risk or is likely to contribute to increased site risk or degradation of the environment/natural resources. These conditions do not exist for the Woman Creek Basin seeps. Also, the OSWER Directive states that, in cases where the cumulative carcinogenic site risk to an individual based on reasonable maximum exposure is less than 10^{-4}, the non-carcinogenic hazard index (HI) is less than 1 and there are no adverse environment impacts, remedial action is generally not warranted. Calculations, assuming an unlikely and highly conservative exposure scenario, indicate public health risks resulting from the seeps is significantly less than 10^{-4}, or 1 in the case of HI. Actual public health risks are not significant and approach zero. Also, there are no adverse environmental impacts resulting from the seeps.

This IM/IRAP/EA is an integrated Comprehensive Environmental Response, Compensation and Liability Act/Resource Conservation and Recovery Act/National Environmental Policy Act (CERCLA/RCRA/NEPA) document. The NEPA/CERCLA integration is pursuant to DOE Order 5400-4. The document has been prepared to conform with the requirements for an Engineering Evaluation/Cost Analysis (EE/CA) as defined in the National Contingency Plan (NCP) (FR Vol. 55, No. 46, 8813; 40 CFR 300.415[b][4]). It also conforms to the NEPA of 1969, as implemented by regulations promulgated by the President's Council on Environmental

Quality (CEQ) (40 CFR 1500-1508), and Department of Energy (DOE) Guidelines (52 FR 47622-47670, December 15, 1987).

1.1 BACKGROUND

In March 1987, a Phase I Remedial Investigation (RI) under the Environmental Restoration (ER) Program [formerly known as the Comprehensive Environmental Assessment and Response Program (CEARP)] began at OU 2. The investigation consisted of the preparation of detailed topographic maps, radiometric and organic vapor screening surveys, surface geophysical surveys, a soil gas survey, a boring and well completion program, soil sampling, and ground and surface water sampling. Phase I field activities were completed at OU 2 during 1987, and a draft RI report was submitted to EPA and the Colorado Department of Health (CDH) on December 31, 1987 (Rockwell International, 1987a). Phase I data did not allow adequate definition of the nature and extent of contamination for the purpose of conducting a baseline risk assessment and a feasibility study of remedial alternatives pertaining to contaminated media. A draft Phase II RI Sampling Plan that presents the details and rationale for further field work to achieve these objectives was submitted to the regulatory agencies in June 1988 (Rockwell International, 1988a). This draft sampling plan was subsequently revised and submitted as a final Phase II RCRA Facility Investigation/Remedial Investigation Feasibility Study (RFI/RIFS) sampling plan in April 1990 (EG&G, 1990a). The plan was approved by EPA in May 1990. Work plan calls for boreholes to be drilled into waste sources to characterize any waste materials remaining in place and to assess the maximum contaminant concentrations in soils directly beneath the sites. In addition, ground-water monitor wells will be installed adjacent to some of the boreholes to characterize ground-water quality directly beneath the sites. Additional alluvial monitoring wells will be installed to further characterize and monitor ground-water flow and quality in alluvial materials at the OU2. Bedrock monitoring wells will be completed in subcropping Arapahoe sandstone where it is encountered.

A draft IM/IRAP for contaminated ground water at OU 2 was submitted in December 1989 (Rockwell International, 1989a). The plan was prepared based on limited knowledge of the nature and extent of ground-water contamination. Regulatory agency review of the document determined that, although an IM/IRA for ground water is required by the 1989 Agreement in Principle between DOE and CDH, insufficient information exists on the nature and extent of ground-water contamination to pursue effective ground-water remediation at this time. In order to facilitate early evaluation of the need for an IM/IRA for ground water at OU 2, the final Phase II RFI/RIFS sampling plan incorporates a phased investigation approach. The plan was approved by the regulatory agencies. The phased approach is to investigate alluvial and hydraulically connected bedrock migration pathways first, and then to subsequently investigate ground-water contaminant sources. This will allow planning, design, and implementation of a ground-water IM/IRA, if necessary, before completion of the RFI/RI and Corrective Measures Study/Feasibility Study (CMS/FS) for OU 2.

In February and March 1990, representatives from the U.S. Department of Energy (DOE), EPA, and the Colorado Department of Health (CDH) met to discuss surface water IM/IRAs at the RFP site. The result of these meetings was a series of agreements, with the concurrence of all parties, to implement an IM/IRA for the cleanup of contaminated surface water in OU 2. On 26 September 1990, the DOE released for public comment a proposed Surface Water IM/IRA Plan and Decision Document for OU 2. In this Plan, specific point source locations in the South Walnut Creek and Woman Creek drainage basins were proposed for collection of surface water. According to the Plan, surface water collected in each basin was to be transferred to a treatment facility discharging to the South Walnut Creek drainage. Effluent would ultimately flow to Pond B-5, where water is monitored, treated as necessary, and discharged in accordance with the RFP's National Pollutant Discharge Elimination System (NPDES). Comments on the IM/IRAP received during the public comment period, however, revealed strong opposition to the transfer of radionuclide-contaminated seep water from the Woman Creek drainage to the South Walnut Creek drainage. Opposition was based on the absence of a proven performance record for the proposed IM/IRA treatment facility with respect to radionuclide removal, and the potential for treatment process upsets. In addition, the public voiced strong concern over potential worker and public health risks resulting from construction activities in the Woman Creek Basin (i.e., atmospheric suspension of radionuclide-contaminated dust). In light of these concerns, the DOE and regulatory agencies agreed to eliminate the proposed interbasin transfer of surface water within this IM/IRAP, and to address collection and treatment of Woman Creek seepage under a separate IM/IRAP that included IM/IRA alternatives that did not require interbasin transfer of Woman Creek surface water (IM/IRA Alternative No. 4 satisfies this commitment). EPA mandated that treatability studies of various treatment technologies were to be conducted in the Spring of 1991 to provide performance data for radionuclide removal. However, seep flows were insufficient for collection of an adequate volume with sufficient levels of radionuclides for conduct of these studies. As subsequently discussed with EPA and CDH, it was agreed that the Woman Creek Basin IM/IRAP/EA would be prepared in the absence of such studies to avoid project delays. However, this IM/IRAP/EA demonstrates that no further action is required for the Woman Creek Basin seeps at this time. In contrast, the South Walnut Creek Basin IM/IRA is being implemented and may prove to significantly reduce or eliminate VOCs in the downstream detention pond, Pond B-5.

1.2 IM/IRAP ORGANIZATION

Section 2 of this IM/IRAP provides site characterization information on the RFP and, in particular, OU 2. The discussion presented includes site characterization information for both the South Walnut Creek Basin and the Woman Creek Basin at OU 2. Although the primary purpose of this plan is to address contaminated Woman Creek Basin surface waters, it is useful to examine the characteristics of both basins. The discussion presented in Section 2 describes the potentially affected environment associated with the IM/IRA and the results of the previous investigations at OU 2. The information included in Section 2 has been derived from the draft RI report and final Phase II RFI/RIFS Work Plan.

Section 3 identifies the objectives of a Woman Creek Basin Surface Water IM/IRAP/EA. Applicable or Relevant and Appropriate Requirements (ARARs) and applicable environmental regulations pertinent to remediation of Woman Creek Basin seep water are also presented in this section.

Section 4 presents a detailed assessment of the No Action Alternative and identifies technically feasible IM/IRA alternatives for the collection and treatment of contaminated Woman Creek Basin seep water. The surface water collection and treatment alternatives presented in this section were established with regard to achieving remedial action clean-up goals (i.e., ARARs). The alternatives are critically evaluated based on effectiveness, implementability, environmental impact, and cost criteria.

Section 5 presents a comparative summary of the CERCLA/NEPA evaluation results for the IM/IRA performed in Section 4. The comparative analysis will aid in the selection of an IM/IRA for collection and treatment of contaminated Woman Creek Basin seeps if it becomes necessary prior to conduct of final OU 2 remedial action.

Section 6 summarizes the No Action Alternative (i.e, the preferred alternative for the Woman Creek Basin Surface Water IM/IRA).

Volume II of this IM/IRAP contains OU 2 surface water, sediment, ground-water, and soils chemistry data as well as the Woman Creek Basin Surface Water IM/IRA/EA schedule, and a tabulation of ARARs. It also includes details of all risk assessments performed for this plan.

SECTION 2

SITE CHARACTERIZATION

2.1 SITE DESCRIPTION AND BACKGROUND

2.1.1 Location and Facility Type

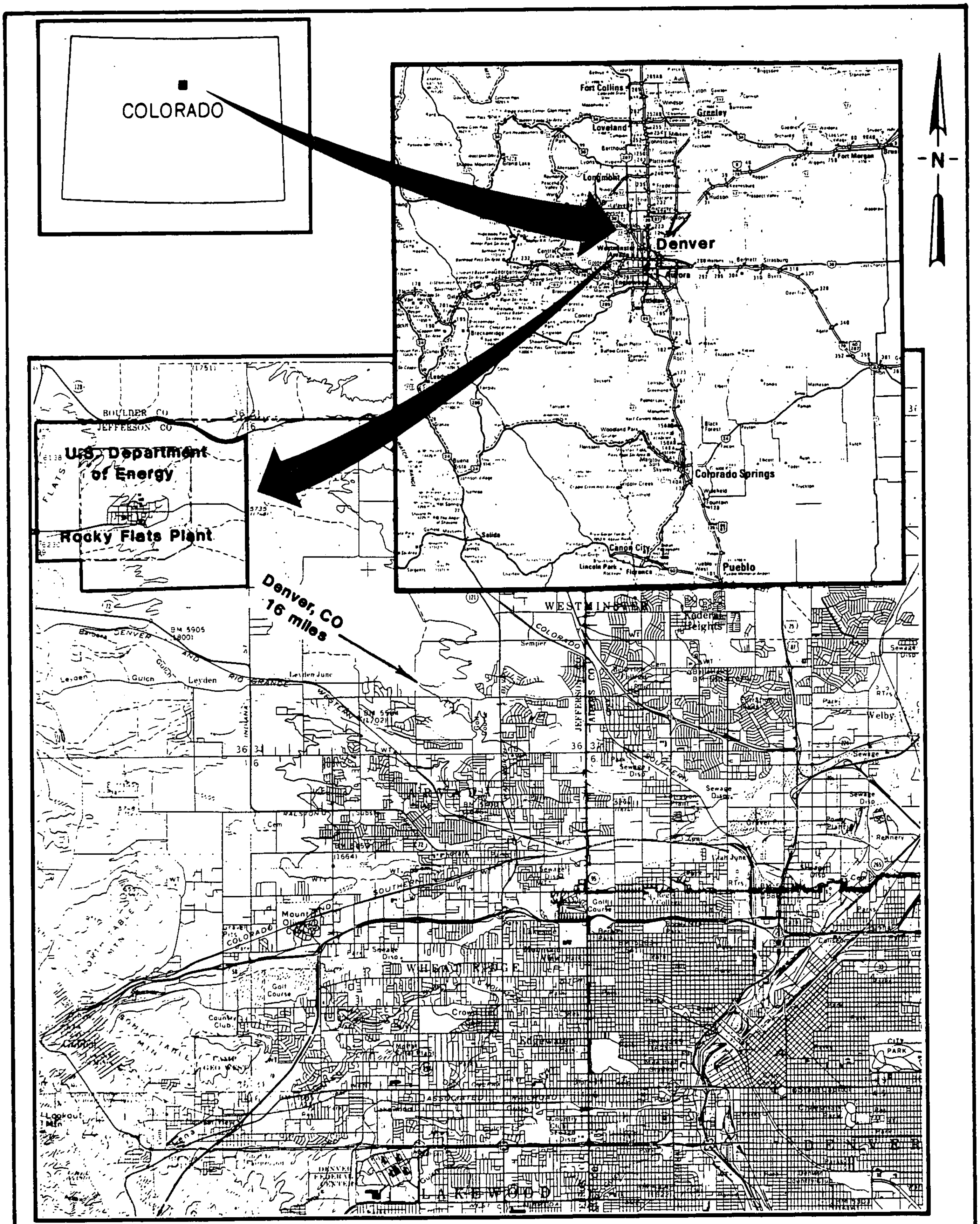
The RFP is located in northern Jefferson County, Colorado, approximately 16 miles northwest of downtown Denver (Figure 2-1). The plant site consists of approximately 6,550 acres of federally-owned land in Sections 1 through 4, and 9 through 15, of Township 2 South, Range 70 West, 6th principal meridian. Plant buildings are located within an area of approximately 400 acres, known as the RFP security area. The security area is surrounded by a buffer zone of approximately 6,150 acres.

The RFP is a government-owned, contractor-operated (GOCO) facility. It is part of a nationwide nuclear weapons research, development, production, and plutonium reprocessing complex, and is administered by the Rocky Flats Operations Office of the DOE. The operating contractor for the RFP is EG&G Rocky Flats, Inc. The facility manufactures components for nuclear weapons and conducts plutonium reprocessing and has been in operation since 1951. The RFP fabricates components from plutonium, uranium, beryllium, and stainless steel. Historically, production activities have included metal fabrication, machining, and assembly. Both radioactive and nonradioactive wastes are generated in the process. Current waste handling practices involve on-site and off-site recycling of hazardous materials and off-site disposal of solid radioactive and mixed wastes at another DOE facility.

The RFP is currently an interim status RCRA hazardous waste treatment/storage facility. In the past, both storage and disposal of hazardous and radioactive wastes occurred at on-site locations. Preliminary assessments conducted under Phase I of the ER Program identified some of the past on-site storage and disposal locations as potential sources of environmental contamination.

2.1.2 Operable Unit No. 2 Description

OU 2 is comprised of the 903 Pad and Lip, Mound, and East Trenches Areas which are located east-southeast of the RFP as shown in Figure 2-2. (Also see Figure 2-4.) The Areas of OU 2 lie within either the Woman Creek or South Walnut Creek drainage basins. Although this IM/IRAP/EA exclusively addresses seeps within the Woman Creek drainage basin, it is useful to examine the historical uses and characteristics of all OU 2 Areas. Twenty sites, designated as IHSSs, lie within OU 2: 5 in the 903 Pad Area, 4 in the Mound Area, and 11 in the East Trenches Areas. The historical use of the OU 2 IHSSs is discussed below.



Not To Scale

Figure 2-1 : Location of Rocky Flats Plant

2.1.2.1 903 Pad Area

Five sites are located within the 903 Pad Area (Figure 2-2). These sites are:

- 903 Drum Storage Site (IHSS Ref. No. 112)
- 903 Lip Site (IHSS Ref. No. 155)
- Trench T-2 Site (IHSS Ref. No. 109)
- Reactive Metal Destruction Site (IHSS Ref. No. 140)
- Gas Detoxification Site (IHSS Ref. No. 183)

Presented below are brief descriptions of each of these sites that are based on the CEARP Phase 1 RFP Installation Assessment (DOE, 1986).

1. 903 Drum Storage Site (IHSS Ref. No. 112) -- The site was used from 1958 to 1967 to store drums containing radioactively-contaminated, used machine cutting oil. The drums, some of which corroded and leaked, contained oils and solvents contaminated with plutonium or uranium. Most of the drums contained lathe coolant consisting of mineral oil and carbon tetrachloride (CCl_4) in varying proportions. However, an unknown number of drums contained hydraulic oils, vacuum pump oils, trichloroethene (TCE), tetrachloroethene (PCE), silicone oils, and acetone (Rockwell International, 1987b). Ethanolamine was also added to new drums after 1959 to reduce the drum corrosion rate. All drums were removed by 1968.

   After the drums were removed, efforts were made to scrape and move the plutonium-contaminated soil into a relatively small area, cover it with fill material, and top it with an asphalt containment cover. This remedial action was completed in November 1969. An estimated 5,000 gallons of liquid leaked into the soil during use of the drum storage site. The liquid was estimated to contain 86 grams of plutonium (Rockwell International, 1987b).

2. 903 Lip Site (IHSS Ref. No. 155) -- During drum removal and clean-up activities associated with the 903 Drum Storage Site, winds distributed plutonium beyond the pad to the south and east. Although some plutonium-contaminated soils were removed, radioactive contamination is still present at the 903 Lip Site in the surficial soils.

3. Trench T-2 Site (IHSS Ref. No. 109) -- This trench was used prior to 1968 for the disposal of sanitary sewage sludge and flattened drums contaminated with uranium and plutonium.

4. Reactive Metal Destruction Site (IHSS Ref. No. 140) -- This site was used during the 1950s and 1960s primarily for the destruction of lithium metal (DOE, 1986). Small quantities of other reactive metals (sodium, calcium, and magnesium) and some solvents were also destroyed at this location (Illsley, 1978).

5. Gas Detoxification Site (IHSS 183) -- Building 952, located south of the 903 Drum Storage Site, was used to detoxify various bottled gases between June 1982 and August 1983. The gases consisted of nitrogen oxides, chlorine, hydrogen sulfide, sulphur tetrafluoride, methane, hydrogen fluoride, and ammonia. Gas detoxification was accomplished by using various commercial neutralization processes available at the time. The neutralized gases released to the environment during detoxification would no longer be detectable (Rockwell International, 1987c).

   A Phase I RI has been completed for these five sites. Phase II is planned for the fall of 1991.

2.1.2.2 Mound Area

The Mound Area is composed of four sites (Figure 2-2). These are:

- Mound Site (IHSS Ref. No. 113)
- Trench T-1 Site (IHSS Ref. No. 108)
- Oil Burn Pit No. 2 Site (IHSS Ref. No. 153)
- Pallet Burn Site (IHSS Ref. No. 154)

These sites are described individually below.

1. Mound Site (IHSS Ref. No. 113) -- The Mound Site contained approximately 1,405 drums containing primarily depleted uranium- and plutonium-contaminated lathe coolant. Some drums also contained "Perclene" (Smith, 1975). Perclene was a brand name of tetrachloroethene (Sax and Lewis, 1987). Some of the drummed wastes placed in the Mound Site were in solid form (Rockwell International, 1987b). Cleanup of the Mound Site was accomplished in 1970, and the materials that were removed were packaged and shipped to an off-site DOE facility as radioactive waste. Subsequent surficial soils sampling in the vicinity of the excavated Mound Site indicated 0.8 to 112.5 disintegrations per minute per gram (d/m/g) alpha activity. This radioactive contamination is thought to have come from the 903 Drum Storage Site via wind dispersion rather than from the Mound Site (Rockwell International, 1987a).

2. Trench T-1 Site (IHSS Ref. No. 108) -- The trench was used from 1954 until 1962 and contains approximately 125 drums filled with depleted uranium chips (Dow Chemical, 1971) and plutonium chips coated with lathe coolant. The drums are still present in this trench.

3. Oil Burn Pit No. 2 Site (IHSS Ref. No. 153) -- Oil Burn Pit No. 2 is actually two parallel trenches which were used in 1957 and from 1961 to 1965 to burn 1,082 drums of oil containing uranium (Rockwell International, 1987b). The residues from the burning operations and some flattened drums were covered with backfill. Clean-up operations were performed in the 1970s (Rockwell International, 1987b).

4. Pallet Burn Site (IHSS Ref. No. 154) -- An area southwest of Oil Burn Pit No. 2 was reportedly used to destroy wooden pallets in 1965. The types of hazardous substances or radionuclides that may have been spilled on these pallets is unknown. Clean-up actions were performed in the 1970s (DOE, 1986).

2.1.2.3 East Trenches Area

The East Trenches Area consists of nine burial trenches and two spray irrigation areas (Figure 2-2). The trench numbers and their respective IHSS designations are:

- Trench T-3 -- IHSS Ref. No. 110
- Trench T-4 -- IHSS Ref. No. 111.1
- Trench T-5 -- IHSS Ref. No. 111.2
- Trench T-6 -- IHSS Ref. No. 111.3
- Trench T-7 -- IHSS Ref. No. 111.4
- Trench T-8 -- IHSS Ref. No. 111.5
- Trench T-9 -- IHSS Ref. No. 111.6
- Trench T-10 -- IHSS Ref. No. 111.7
- Trench T-11 -- IHSS Ref. No. 111.8

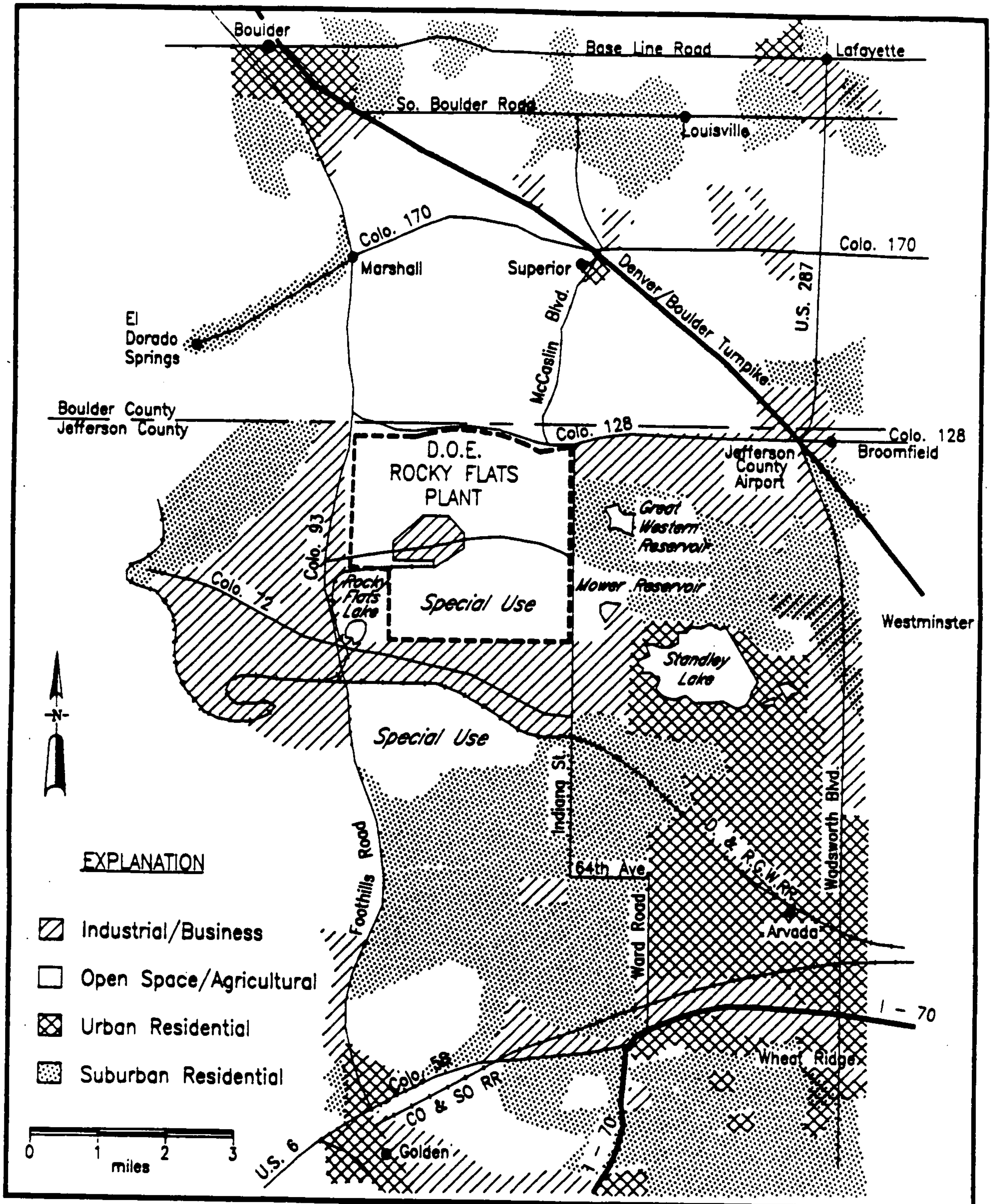
Trenches T-3, T-4, T-10, and T-11 are located north of the east access road, and trenches T-5 through T-9 are located south of the east access road. The trenches were used from 1954 to 1968 for disposal of depleted uranium, flattened depleted uranium- and plutonium-contaminated drums, and sanitary sewage sludge. The wastes have not been disturbed since their burial.

IHSS numbers 216.2 and 216.3 are part of the East Trenches Area and are designated as IHSSs because they were used for spray irrigation of sewage treatment plant effluent. The historical discharge of Pond B-3 was to this spray irrigation area. This practice has been terminated however, and the current Pond B-3 discharge is sent to Pond B-4.

2.1.3 <u>Surrounding Land Use and Population Density</u>

The RFP property is located in a rural area. Approximately 50 percent of the area within 10 miles of the RFP is in Jefferson County. The remainder is located in Boulder County (40 percent) and Adams County (10 percent). According to the 1973 Colorado Land Use Map, 75 percent of this land was unused or was used for agriculture. Since that time, portions of this land have been converted to housing, with several new housing subdivisions being started within a few miles of the buffer zone, southeast of the plant site. Land zoning is depicted in Figure 2-3.

A demographic study, using 1990 census data, shows that approximately 1.9 million people lived within the eight-county Denver metropolitan region. This region covers approximately 5,076 square miles and includes the following counties: Adams, Arapahoe, Boulder, Clear Creek, Denver, Douglas, Gilpin, and



(after: Jefferson County Planning and Zoning Department, April, 1990)

FIGURE 2-3

LAND ZONING IN THE VICINITY OF ROCKY FLATS PLANT

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Jefferson. The most populated sector is to the southeast, toward the center of Denver. This sector had a 1989 population of approximately 600,000 people living between 10 and 50 miles from Rocky Flats. Recent population estimates registered by the Denver Regional Council of Governments (DRCOG) for the eight-county Denver metro region have shown distinct patterns of growth between the first and second halves of the decade.

Between 1980 and 1985, the population of the eight-county region increased by 197,890, a 2.4 percent annual growth rate (DRCOG, 1989). Between 1985 and 1990 a population gain of 80,875 was recorded, representing a 0.9 percent annual increase. The 1990 population showed an increase of 9,300 (or 0.5 percent) from the same date in 1989 (DRCOG, 1990).

The RFP property is approximately 3 miles (north-south) by 4 miles (east-west). There are eight public schools within 6 miles of the RFP. The nearest educational facility is the Witt Elementary School, which is approximately 2.7 miles east of the Plant buffer zone. The closest hospital is Centennial Peaks Hospital, located approximately 7 miles northeast. The closest park and recreational area is the Standley Lake area, which is approximately 5 miles southeast of the Plant. Boating, picnicking, and limited overnight camping are permitted. Several other small parks exist in communities within 10 miles. The closest major park, Golden Gate Canyon State Park, located approximately 15 miles to the southwest, provides 8,400 acres of general camping and outdoor recreation. Other national and state parks are located in the mountains west of the RFP, but all are more than 15 miles away.

Some of the land adjacent to the Plant is zoned for industrial development. Industrial facilities within 5 miles include the former TOSCO (The Oil Shale Company) laboratory (40-acre site located 2 miles south and now occupied by Analytica, Inc.), the Great Western Inorganics Plant (2 miles south), the Frontier Forest Products yard (2 miles south), the Idealite Lightweight Aggregate Plant (2.4 miles northwest), and the Jefferson County Airport and Industrial Park (990-acre site located 4.8 miles northeast).

Several ranches are located within 10 miles of the Plant, primarily in Jefferson and Boulder Counties. They are operated to produce crops, raise beef cattle, supply milk, and breed and train horses. According to the 1987 Colorado Agricultural Statistics, 20,758 acres of crops were planted in Jefferson County (total land area of approximately 475,000 acres), and 68,760 acres of crops were planted in Boulder County (total land area of 405,760 acres). Crops consisted of: winter wheat, corn, barley, dry beans, sugar beets, hay, and oats. Livestock consisted of: 5,314 head of cattle, 113 hogs, and 346 sheep in Jefferson County, and 19,578 head of cattle, 2,216 hogs, and 12,133 sheep in Boulder County (Post, 1989).

2.2 AFFECTED ENVIRONMENT

2.2.1 Physical Environment

The natural environment of the Plant and vicinity is primarily influenced by its proximity to the Front Range of the Rocky Mountains. The Plant is directly east of the north-south trending Rocky Mountains, with an elevation of approximately 6,000 feet above sea level. The RFP is located on a broad, eastward-sloping plain of overlapping alluvial fans developed along the Front Range. The fans extend about 5 miles in an eastward direction from their origin in the abruptly rising Front Range and terminate on the east at a break in slope to low rolling hills. The continental divide is about 16 miles west of the Plant. The operational area at the Plant is located near the eastern edge of the fans on a terrace between stream-cut valleys (North Walnut Creek and Woman Creek). The Rocky Flats Alluvium (the deposit of coalescing alluvial fans) is exposed at the surface and consists of a topsoil layer underlain by as much as 100 feet of silt, clay, sand, and gravel.

Mineral resources found in the vicinity of RFP include sand, gravel, crushed rock, clay, coal, and uranium. There are no known clay, coal or uranium deposits within the RFP buffer zone; however, these commodities are mined in the region, within 20 miles of the plant. The Schwartzwalder Uranium Mine is located approximately 4 miles southwest of the RFP. The mine has been the largest producer of vein type uranium ore in Colorado and ranks among the six largest of this type in the United States (DOE, 1980). Active sand and gravel mines lie within the buffer zone boundaries. There is an aggregate processing facility adjacent to the northwest corner of the buffer zone which reopened in 1989. Oil and natural gas production is also active in nearby northwest Adams County and east central Boulder County.

Oil and natural gas activity near the RFP site includes oil field developments, pipeline, and production operations. The closest major oil and gas fields are in northwest Adams County (Jackpot and Spindle Fields), and a smaller field occurs in east central Boulder County (Boulder Field). A natural gas pipeline, which originates in Wyoming and proceeds across eastern Colorado into Oklahoma, is located approximately 10 miles north of the Plant in southern Boulder County. Local natural gas pipelines cross the south side of the RFP. The nearest refinery operation is the Conoco Refinery located in Commerce City about 20 miles east of the Plant. A north-south oriented oil pipeline feeds in to the refinery from fields in northeastern Colorado and southeastern Wyoming (Donaldson and MacMillan, 1980).

There are four main drainages from the Plant property as shown in Figure 2-4. North Walnut, South Walnut, Rock, and Woman Creeks all have intermittent streams. These drainages enter downstream reservoirs that provide drinking and irrigation water. There are a number of ditches crossing the area as well that convey water collected off site to other areas of the Plant, Walnut Creek, or Woman Creek. Until late 1974, Plant wastewater had been discharged to Walnut Creek, and until 1975, filter backwash from the raw water treatment

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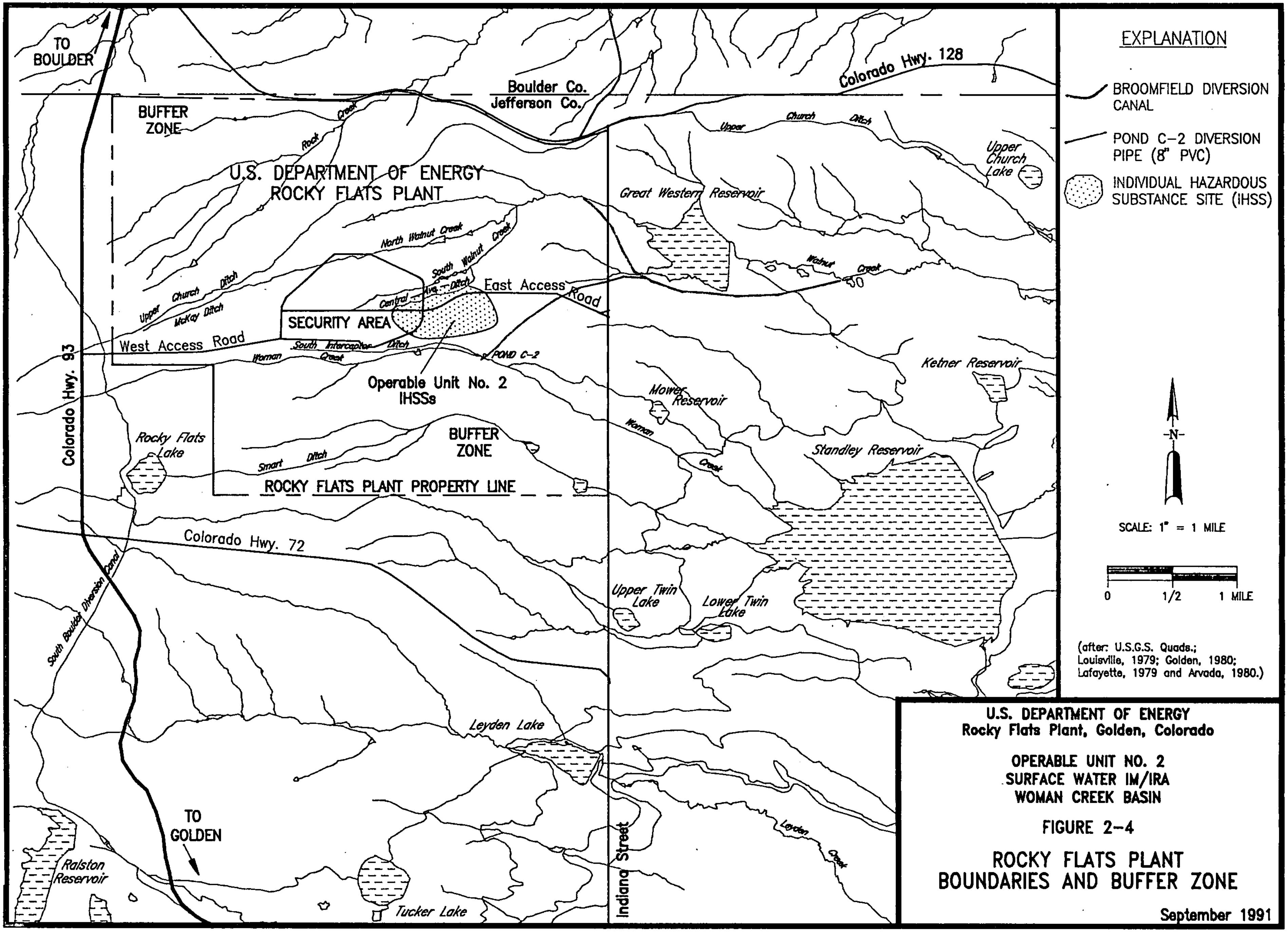

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

OPERABLE UNIT NO. 2
SURFACE WATER IM/IRA
WOMAN CREEK BASIN

FIGURE 2-4

ROCKY FLATS PLANT BOUNDARIES AND BUFFER ZONE

September 1991

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plant went into Woman Creek. All process wastewater is now either recycled or disposed through evaporation. Sanitary wastewater is discharged in accordance with the RFP's National Pollutant Discharge Elimination System (NPDES) permit effluent requirements.

2.2.2 Regional and Local Geology

The stratigraphic section that pertains to the RFP includes, in descending order, unconsolidated surficial units (Rocky Flats Alluvium, various terrace alluviums, valley fill alluvium, and colluvium) (Figure 2-5), Arapahoe Formation, Laramie Formation, and Fox Hills Sandstone (Figure 2-6). Ground water occurs under unconfined conditions in both the surficial and shallow bedrock units. In addition, confined ground water flow occurs in deeper bedrock sandstones.

2.2.2.1 Alluvial Materials

The Rocky Flats Alluvium underlies a large portion of the Plant. The alluvium is a broad planar deposit consisting of a topsoil layer underlain by up to 100 feet of poorly stratified silt, clay, sand, gravel, and cobbles.

Unconfined ground-water flow occurs in the Rocky Flats Alluvium which is relatively permeable. Recharge to the alluvium is from precipitation, snowmelt, and water losses from ditches, streams, and ponds that are cut into the alluvium. General water movement in the Rocky Flats Alluvium is from west to east and toward the drainages. (Ground-water flow is also controlled by paleochannels in the top of the bedrock.) The water table in the Rocky Flats Alluvium rises in response to recharge during the spring and declines during the remainder of the year. Discharge from the alluvium occurs at minor seeps in the colluvium that covers the contact between the alluvium and bedrock along the edges of the valleys. OU 2 is situated on a terrace of Rocky Flats Alluvium that thins east of the Plant and does not directly supply water to wells located downgradient of Rocky Flats.

Various other alluvial deposits occur topographically below the Rocky Flats Alluvium in the Plant drainages. Colluvium (slope wash) mantles the valley side slopes between the Rocky Flats Alluvium and the valley bottoms. In addition, remnants of younger terrace deposits including the Verdos, Slocum, and Louviers Alluvia occasionally occur along the valley side slopes. Recent valley fill alluvium occurs in the active stream channels.

Unconfined ground-water flow occurs in these surficial units. Recharge is from precipitation, percolation from streams and ditches during periods of surface water runoff, and by seeps discharging from the Rocky Flats Alluvium. Discharge is by seepage into other geologic formations and streams, and by evaporation where the water table approaches the ground surface. The direction of ground-water flow is generally downslope

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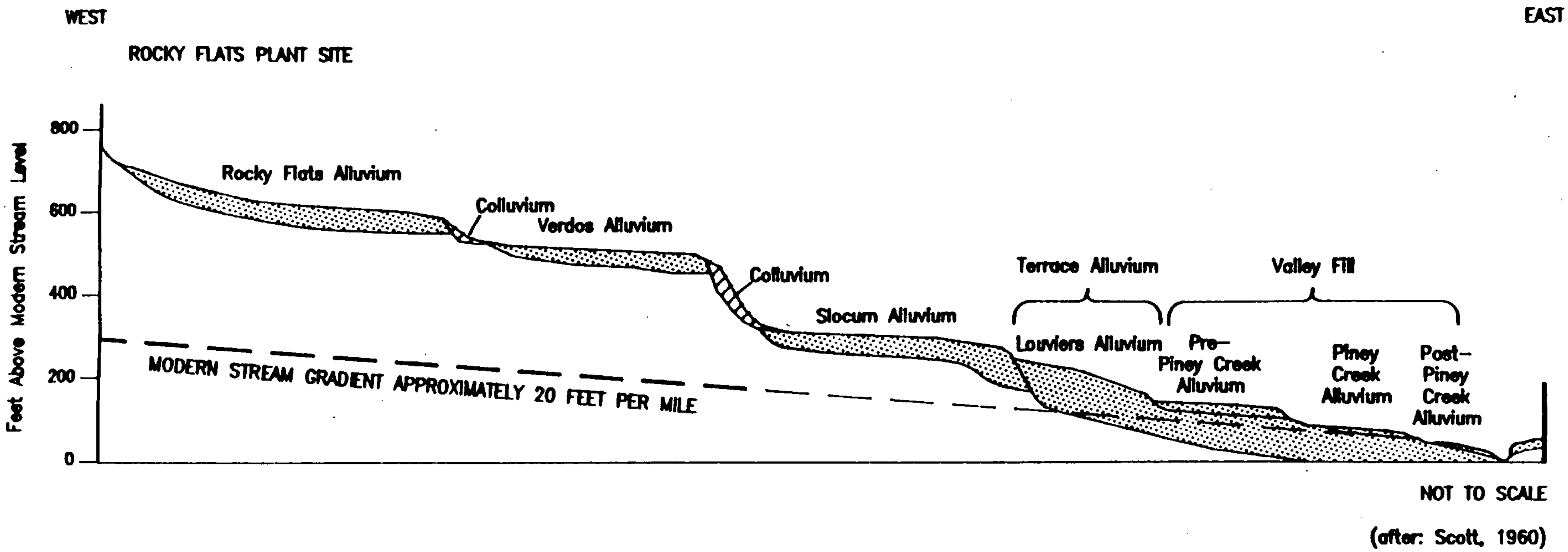
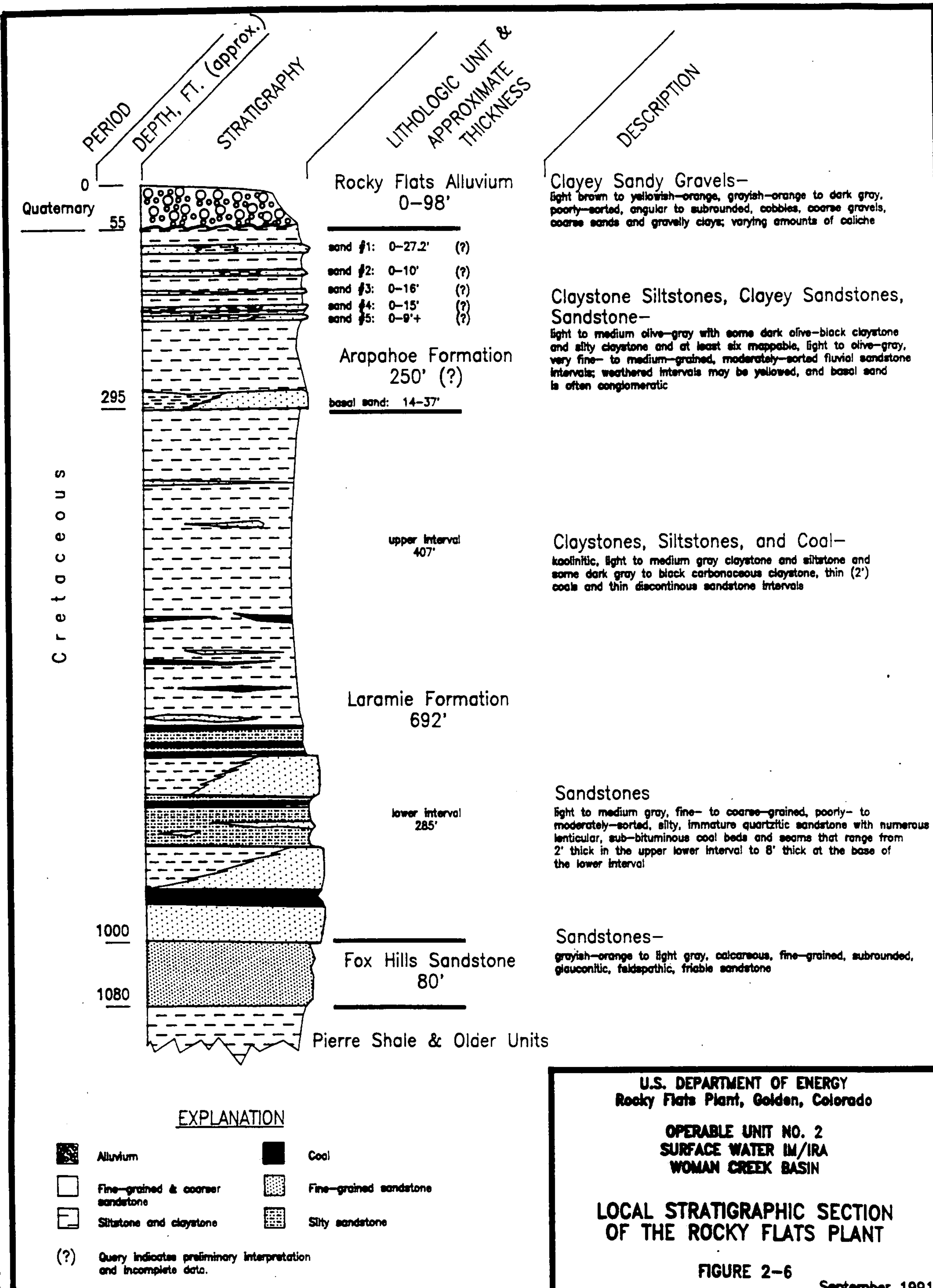


FIGURE 2-5

EROSIONAL SURFACES AND ALLUVIAL DEPOSITS EAST OF THE FRONT RANGE, COLORADO



U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant, Golden, Colorado

OPERABLE UNIT NO. 2
SURFACE WATER IM/IRA
WOMAN CREEK BASIN

LOCAL STRATIGRAPHIC SECTION OF THE ROCKY FLATS PLANT

FIGURE 2-6

September 1991

through colluvial materials and then along the course of the stream in valley fill materials. During periods of high surface water flow, water is lost to bank storage in the valley fill alluvium and returns to the stream after the runoff subsides.

2.2.2.2 Bedrock Materials

The Cretaceous Arapahoe Formation underlies surficial materials beneath the Plant. This formation is a fluvial deposit composed of overbank and channel deposits. It consists primarily of claystone with some sandstone and is nearly flat lying beneath the Plant (less than a 2-degree dip) based on the draft seismic profiling report (Rockwell International, 1989a). The sand bodies within the claystone are composed of fine-grained sands and silts, and their hydraulic conductivity is relatively low compared to the overlying Rocky Flats Alluvium. Total formation thickness varies up to 270 feet (Robson, et. al., 1981a).

The Arapahoe Formation is recharged by ground-water movements from overlying surficial deposits and by leakage from streams. The main recharge areas are under the Rocky Flats Alluvium, although some recharge from the colluvium and valley fill alluvium is likely to occur along the stream valleys. Recharge is greatest during the spring and early summer when rainfall and stream flow are at a maximum and water levels in the Rocky Flats Alluvium are high. Ground-water movement in the Arapahoe Formation is generally toward the east, although flow within individual sandstones is not fully characterized at this time. Regionally, ground-water flow in the Arapahoe Formation is toward the South Platte River in the center of the Denver Basin (Robson, 1981a).

The Laramie Formation underlies the Arapahoe Formation and is composed of two units, a thick upper claystone and a lower sandstone. The claystone is greater than 700 feet thick and is of very low hydraulic conductivity; therefore, the U.S. Geologic Survey (Hurr, 1976) concludes that Plant operations will not impact any units below the upper claystone unit of the Laramie Formation.

The lower sandstone unit of the Laramie Formation and the underlying Fox Hills Sandstone comprise a regionally important aquifer in the Denver Basin known as the Laramie-Fox Hills Aquifer. Aquifer thickness ranges from 200 to 300 feet near the center of the basin. These units subcrop west of the Plant and can be seen in clay pits excavated through the Rocky Flats Alluvium. The steeply dipping beds of these units west of the Plant (approximately a 50-degree dip) quickly flatten to the east (less than 2-degree dip) based on preliminary results of the high resolution seismic reflection study (Rockwell International, 1989a). Recharge to the aquifer occurs along the rather limited outcrop area exposed to surface water flow and leakage along the Front Range (Robson, 1981b). In the vicinity of the RFP, this would occur west of the plant where the units subcrop.

Sixteen wells were completed in various zones within bedrock during the 1987 drilling program at OU 2. Although claystone was the most frequently encountered lithology immediately below the alluvium/bedrock contact, interbedded sandy, silty, and lignitic units with both gradational and sharp contacts were present as well. All of the bedrock encountered directly beneath surficial materials was weathered, and some saturated sandstones were encountered.

2.2.3 Site Hydrology

2.2.3.1 Surface Water

Surface water drainage patterns at the RFP are shown on Figures 2-2 and 2-4. A discussion of the major OU 2 surface water features, including the Woman Creek and South Walnut Creek drainages, is presented below. Although this IM/IRAP/EA addresses contaminated Woman Creek Basin surface water, the South Walnut Creek Basin drainage is included in the following discussion to provide a complete description of OU 2 hydrology. Collection and treatment of the South Walnut Creek Basin surface water and seepage is being addressed in an IM/IRA as discussed in Section 1.

Woman Creek

Woman Creek is located south of the Plant, with headwaters in largely undisturbed Rocky Flats Alluvium. Runoff from the southern part of the Plant is collected in the South Interceptor Ditch (SID) located north of the creek and delivered downstream to Pond C-2 (see Figure 2-2). Pond C-1 (upstream of C-2) receives stream flow from Woman Creek. Flow in Woman Creek is also influenced by diversion of water from Rocky Flats Lake into the creek by local landowners. The discharge from Pond C-1 is diverted around Pond C-2 into the Woman Creek channel downstream. Water in Pond C-2 is treated and monitored prior to discharge. Discharge from Pond C-2 is in accordance with the Plant's NPDES permit (discharge point 007). Historically, discharge from Pond C-2 has been to Woman Creek, however, since October of 1989, treated water is being pumped to the South Walnut Creek drainage and flows off site via the Broomfield diversion canal.

Flow in Woman Creek and the SID is intermittent. This has been observed by field investigation crews since 1986.

South Walnut Creek

The headwaters area of South Walnut Creek has been filled during construction of RFP facilities. As a result, flow originates from a buried culvert located west of Building 991. Flow in the upper reach of South

Walnut Creek is directed to the south of Building 991 and under the Protected Area (PA) fence by a buried metal corrugated culvert. The culvert outlet is located in the South Walnut Creek drainage approximately 500 feet downgradient of the PA fence near the discharge of the sewage treatment plant. A concrete culvert and a second metal corrugated culvert also discharge into the South Walnut Creek drainage just downgradient of the PA fence and north of the Mound Area. The flow from the concrete culvert originates as seepage from the hillside south of Building 991 and flows into a ditch along the slope. The metal corrugated culvert drains plant runoff collecting in a drainage south of the PA. The combined flow then enters the South Walnut Creek detention pond system. Below the detention ponds, South Walnut Creek, North Walnut Creek, and an unnamed tributary join within the buffer zone to form Walnut Creek. Great Western Reservoir is located approximately 1 mile east of this confluence and is a drinking water source for Broomfield. Flow is routed around Great Western Reservoir by the Broomfield Diversion Canal.

The South Walnut Creek detention pond system consists of five ponds (B-1, B-2, B-3, B-4, and B-5) that retain surface water runoff and RFP discharges for flood control and for monitoring and treatment prior to downstream release. All flow in the pond system is eventually detained in Pond B-5, where it is treated and monitored prior to discharge. Water is discharged from Pond B-5 in accordance with the Plant's NPDES permit (discharge point 006). Ponds B-1 and B-2 are reserved for spill control, surface water runoff, or treated sanitary waste of questionable quality. Pond B-3 is used as a holding pond for sanitary sewage treatment plant effluent. The historical discharge of Pond B-3 was a spray irrigation system located in the vicinity of the East Trenches. This practice has been terminated, however, and the current Pond B-3 discharge is sent to Pond B-4. In addition to Pond B-3 discharge, Ponds B-4 and B-5 receive surface water runoff from the central portion of the Plant. The surface water runoff received by Pond B-4 is collected by the Central Avenue Ditch and the South Walnut Creek Drainage.

2.2.3.2 Ground Water

Ground water occurs in surficial materials (Rocky Flats Alluvium, colluvium, and valley fill alluvium) and in Arapahoe sandstones and claystones at OU 2. These two flow systems, which are hydraulically connected at shallower portions of the Arapahoe Formation, are discussed separately below.

Ground Water in Surficial Materials

Ground water is present in the Rocky Flats Alluvium, colluvium, and valley fill alluvium under unconfined conditions. Recharge to the water table occurs as infiltration of incident precipitation and as seepage from ditches and creeks. In addition, detention ponds along Woman Creek and South Walnut Creek recharge the valley fill alluvium. Figure 2-7 shows the potentiometric surface of uppermost ground water measured between

April 4, and April 8, 1988, and the locations of alluvial and bedrock wells in the vicinity of OU 2. The potentiometric surface during April 1988 is typical of the spring time water table at OU 2.

The shallow ground-water flow system is quite dynamic, with large water level changes occurring in response to precipitation events and stream and ditch flow. For example, between mid-April and September 1986, water levels in wells 1-86 and 4-86 (completed in valley fill alluvium) dropped more than 4 and 8 feet, respectively. Alluvial water levels are highest during the months of May and June. Water levels decline during late summer and fall, and some wells go completely dry at this time of year. Ground-water flow in the Rocky Flats Alluvium is generally from west to east, following the surface of the claystone bedrock.

Alluvial ground water discharges to seeps, springs, surface water drainages, and subcropping Arapahoe Sandstone at OU 2. Seeps and springs occur along the edge of the Rocky Flats Alluvium terrace (at the alluvium/bedrock contact) and on the side slopes of the terrace. Seeps and springs on the terrace side slopes may be due to thinning of colluvial materials. Ground water in colluvial materials south of the 903 Pad and East Trenches Areas discharges to the SID, and ground water in valley fill materials discharges to Woman or South Walnut Creeks.

Hydraulic conductivity values were estimated for surficial materials from drawdown-recovery tests performed on 1986 wells during the initial site characterization and from slug tests performed on selected 1986 and 1987 wells during the Phase I RI (Rockwell International, 1987a). The average ground-water velocities in the Rocky Flats Alluvium, Woman Creek Valley Fill Alluvium, and South Walnut Creek Valley Fill Alluvium are 84 feet per year (ft/yr), 145 ft/yr, and 20 ft/yr, respectively (Rockwell International, 1987a). These values are based on a horizontal gradient of 0.02 feet per feet (ft/ft), an effective porosity of 0.1, and mean hydraulic conductivities of 4×10^{-4}, 7×10^{-4}, and 9.5×10^{-5} centimeters per second (cm/s) for Rocky Flats, Woman Creek Valley Fill and South Walnut Creek Valley Fill Alluvium, respectively. The calculations assume year-round saturation. However, as discussed above, portions of the Rocky Flats Alluvium, colluvium, and valley fill alluvium are not continuously saturated. Thus, the shallow ground water must flow at less than the calculated annual average velocities. The reactivity of dissolved constituents could further reduce contaminant migration rates below estimated ground-water velocities.

Bedrock Ground Water

The greatest potential for ground-water flow in the Arapahoe Formation occurs in the meandering lenticular sandstones contained within the claystones (i.e., the basal formation) due to their relatively higher permeability. Flow within individual sandstones is assumed to be from west to east, but the geometry of the bedrock ground-water flow path is not fully understood at this time due to its dependence upon the continuity of the sandstones and their hydraulic interconnection (Robson, 1981a). Evaluation of the lateral extent and degree of interconnection of the sandstone units is a primary goal of the Phase II Bedrock RI for OU 2. Ground water recharged to sandstones occurs as infiltration from alluvial ground water where sandstones subcrop beneath the alluvium and by leakage from claystones overlying the sandstones. Ground water from the basal formation of the Arapahoe aquifer is used for irrigation, livestock, watering, and domestic purposes. Wells are located east of the RFP within the Denver Basin.

There is a strong downward gradient between ground water in surficial materials and bedrock. Vertical gradients range from 0.31 ft/ft between wells 35-86 and 34-86 to 1.05 ft/ft between wells 41-86 and 40-86. These gradients imply a relatively high hydraulic conductivity contrast between the surficial materials and bedrock, which is supported by hydraulic conductivity test results.

Hydraulic conductivity values for Arapahoe sandstones were estimated from drawdown-recovery tests performed in 1986, slug tests performed in 1987, and packer tests performed in 1986 and 1987. The maximum horizontal ground-water flow velocity in sandstone is 75 ft/yr using a hydraulic conductivity of 83 ft/yr, a horizontal gradient of 0.09 ft/ft, and an assumed effective porosity of 0.1.

2.2.4 Meteorology and Climatology

The area surrounding the RFP has a semiarid climate characteristic of much of the central Rocky Mountain region. Approximately 40 percent of the 15-inch annual precipitation falls during the spring season, much of it as snow. Thunderstorms (June to August) account for an additional 30 percent of the annual precipitation. Autumn and winter are drier seasons, accounting for 19 and 11 percent of the annual precipitation, respectively. Snowfall averages 85 inches per year, falling from October through May (DOE, 1980). Temperatures are moderate; extremely warm and cold weather is usually of short duration. On the average, daily summer temperatures range from 55°F to 85°F, and winter temperatures range from 20°F to 45°F. The low average relative humidity (46%) is due to the blocking effect of the Rocky Mountains.

Wind, temperature, and precipitation data are collected on the plant site and summarized annually. Table 2-1 presents the 1990 annual summary of the percent frequency of wind directions (16 compass points) divided into 6 speed categories. These frequency values are represented graphically in Figure 2-8. Winds at the RFP are predominantly northwesterly. Winds greater than 4.18 meters per second (m/s) (9.2 miles per hour [mph]) with easterly components occur with a low frequency. The Pasguill Stability Class D represents the prevailing meteorological conditions for the RFP (EG&G, 1991), and average downwind directional frequencies.

Special attention has been focused on dispersion meteorology surrounding the Plant due to the remote possibility that significant atmospheric releases might affect the Denver metropolitan area which is located in

TABLE 2-1

ROCKY FLATS METEOROLOGICAL MONITORING STATION
60 METER TOWER

JANUARY 1, 1990 - DECEMBER 31, 1990

WIND FREQUENCY DISTRIBUTION BY PERCENT – STABILITY CLASS D

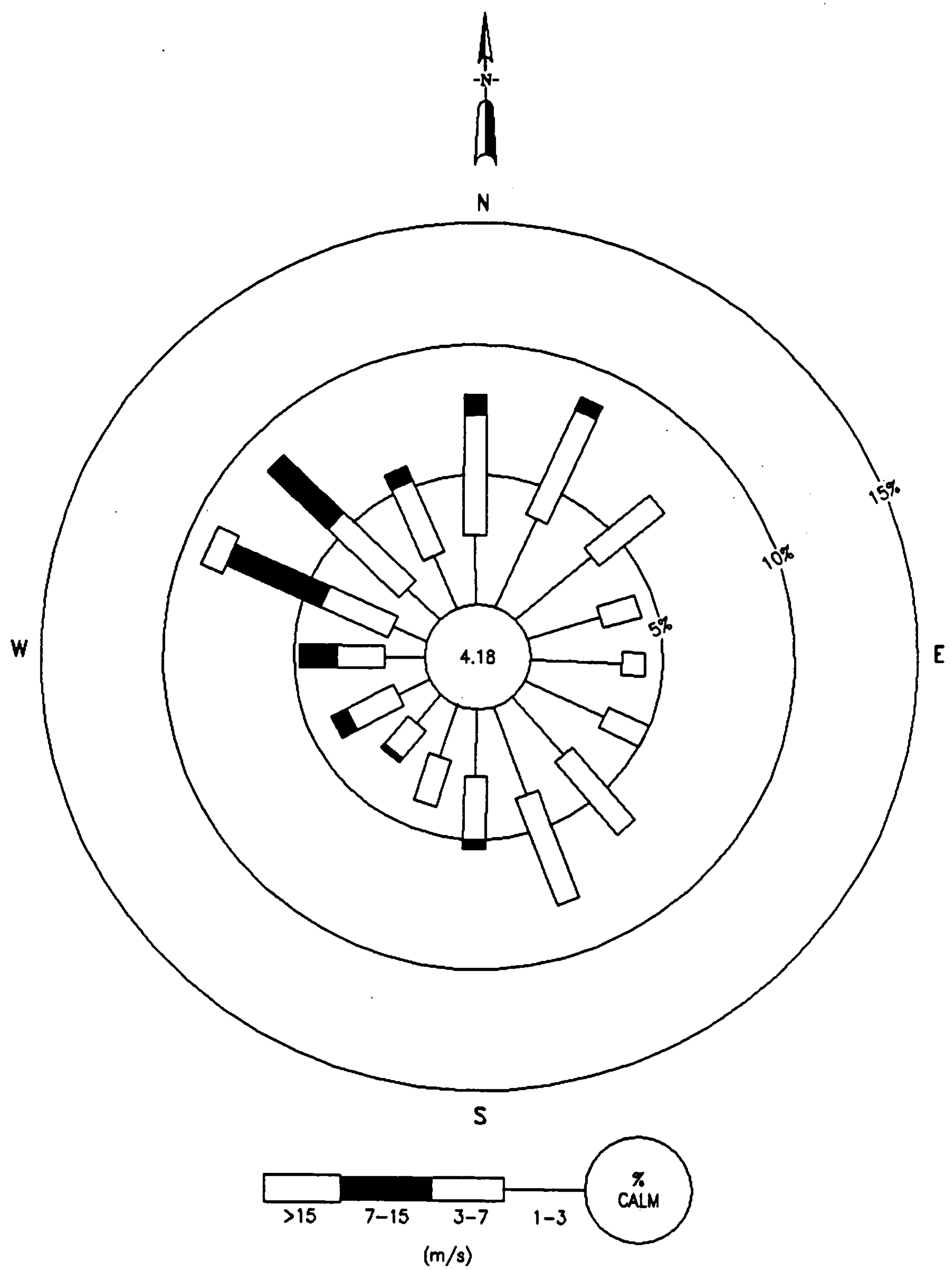
10 METER LEVEL

WIND SPEED CLASSES (KNOTS)

Wind Direction	<3.0	3.0 - <6.0	6.0 - <10.0	10.0 - <16.0	16.0 - <21.0	≥21.0	Class*	Total**
N	0.8	2.9	3.4	1.6	0.2	0.2	9.29	9.25
NNE	1.1	3.5	2.9	1.0	0.0	0.0	8.52	8.49
NE	1.1	3.3	1.6	0.3	0.0	0.0	6.31	6.29
ENE	1.0	2.3	.8	0.1	0.0	0.0	4.20	4.19
E	1.4	3.0	.7	0.0	0.0	0.0	5.06	5.04
ESE	0.9	2.7	1.9	0.1	0.0	0.0	5.60	5.58
SE	0.9	3.5	3.6	0.6	0.0	0.0	8.57	8.54
SSE	0.8	2.5	2.6	0.6	0.1	0.0	6.66	6.64
S	0.7	2.0	1.5	0.5	0.1	0.0	4.79	4.78
SSW	0.5	1.2	1.0	0.3	0.1	0.0	3.09	3.08
SW	0.3	1.2	1.2	0.4	0.1	0.0	3.29	3.28
WSW	0.4	1.1	1.2	1.0	0.4	0.3	4.25	4.24
W	0.5	1.1	1.1	1.6	1.1	1.5	6.89	6.87
WNW	0.5	1.3	1.5	3.0	1.8	1.6	9.59	9.56
NW	0.7	1.6	2.1	2.3	0.7	0.2	7.54	7.51
NNW	0.6	1.9	2.6	1.1	0.1	0.0	6.34	6.32
All	12.1	35.0	29.7	14.6	4.7	3.9	100.00	99.64

* Total Percent for this stability class
** Total percent relative to all stability classes (A through F)

Total Number of invalid observations in this stability class = 18
Total Number of valid observations in this stability class = 18,240
Joint Data Recovery Rate = 99.9%



U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden, Colorado

1990 ANNUAL WIND ROSE
FOR THE ROCKY FLATS PLANT

FIGURE 2-8

R37039.MB080191

the predominant downwind direction (southeast). Studies of air flow and dispersion characteristics (e.g., Hodgin, 1983 and 1984) indicate that drainage flows (winds coming down from the mountains to the west, turn and move toward the north and northeast along the South Platte River valley and pass to the west and north of Brighton, Colorado (DOE, 1980), which is just north of Denver.

2.2.5 Ecology

The RFP site includes species of flora representative of tall grass prairie, short grass plains, lower montane, and foothill ravine regions. It is evident that the vegetative cover along the Front Range of the Rocky Mountains has been altered by human activities such as burning, timber cutting, road building, and overgrazing for many years. Since the acquisition of the RFP property, vegetative recovery has occurred as evidenced by the presence of grasses such as big bluestem and sideoats grama (two disturbance-sensitive species). No vegetative stresses attributable to hazardous waste contamination have currently been identified (DOE, 1980).

The animal life inhabiting the RFP and its buffer zone consists of species associated with western prairie regions. The most common large mammal is the mule deer, with an estimated 100 to 125 permanent residents. There are a number of small carnivores, such as the coyote, red fox, striped skunk, and long-tailed weasel. A profusion of small herbivore species can be found throughout the Plant and buffer zone consisting of species such as the pocket gopher, white-tailed jackrabbit, and the meadow vole (DOE, 1980).

Woman Creek supports an aquatic biota typical of high-prairie streams. Due to the low nutrient content in Woman Creek, the stream supports only small algal populations. Cattails and bullrush are also present. The rocky bottom of Woman Creek supports a relatively diverse biota composed of may flies, caddis flies, and other forms typical of clean water streams. Redside dace minnows are abundant in the streams and ponds; a few bluegill are also present (DOE, 1990).

Bull snakes and rattlesnakes are the most frequently observed reptiles. Eastern yellow-bellied racers have also been seen. The eastern short-horned lizard has been reported on the site, but these and other lizards are not commonly observed. The western painted turtle and the western plains garter snake are found in and around many of the ponds (DOE, 1980).

Commonly observed birds include western meadowlarks, horned larks, morning doves, and vesper sparrow. A variety of ducks, killdeer, and red-winged blackbirds are seen in areas adjacent to ponds. Mallards and other ducks frequently nest and raise young on several of the ponds. Common birds of prey in the area include marsh hawks, red-tailed hawks, ferruginous hawks, rough-legged hawks, Swainson's Hawks, Great Horned Owls, and Burrowing Owls (DOE, 1980).

2.2.6 Threatened and Endangered Species

Relevant laws and regulations which protect threatened and endangered species include: NEPA of 1969, the Endangered Species Act (ESA) of 1973 (Public Law 93-0205), the Clean Water Act (CWA) as amended (33 U.S.C. 1251), and the Migratory Bird Treaty Act (16 U.S.C. 1701-711). Federal agencies must ensure that actions authorized, funded, or carried out by them will not jeopardize the continued existence of any endangered or threatened species (EG&G, 1991).

Studies were conducted at the RFP to identify potential habitat for threatened and endangered species and other species of special concern (EG&G, 1991). A literature search was conducted to obtain information on sensitive species which may be present and data on habitats present on the site. Information on endangered species was obtained from the U.S. Fish and Wildlife Service (USFWS). The U.S. Army Corps of Engineers (COE) was contacted for information on wetland plant species. The Colorado Natural Areas Program and Colorado Division of Wildlife were contacted for information on state plant and animal species of concern. In addition, a local expert on sensitive plant species was contacted for supplementary information on the Colorado butterfly plant (EG&G, 1991).

Habitat potentially suitable for two sensitive plant species, the Colorado butterfly plant (*Gaura neomexicana var. coloradensis*) and the diluvium lady's tresses orchid (*Spiranthes diluvialis*) (a federally proposed threatened species), is present on the site. In addition, habitat potentially suitable for two species of special concern to the State of Colorado, the forktip threeawn (*Aristida basiramea*) and toothcup (*Rotala ramosior*), is also present on the site. However, no individuals of the Colorado butterfly plant, diluvium lady's tresses orchid, forktip threeawn or the toothcup were observed during the reconnaissance surveys. Intensive field studies designed to survey potential habitat for the Federal Category 2 plant species and the plant species of special concern to the State of Colorado will be required to determine if they occur on the RFP site.

The bald eagle (*Haliaeetus leucocephalus*) was identified as occasionally using habitat between 0.3 and 1.1 miles from the RFP site during the winter months. Habitat use by bald eagles on the site is expected to be casual, if it occurs at all.

Potentially suitable habitat is also present for six Federal Category 2 wildlife species, including the white-faced ibis (*Plegadis chichi*), ferruginous hawk (*Buteo regalis*), mountain plover (*Charadrius montanus*), long-billed curlew (*Numenius americanus*), Preble's meadow jumping mouse (*Zapus hudsonius preblei*) and the swift fox (*Vulpes velox*). Insufficient information is available to determine if habitat for the Federal Category 2 Texas horned lizard (*Phyrnosoma cornutum*) is present on the site. Habitat potentially suitable for the western snow plover (*Charadrius alexandrinus nivosus*) is not present on the RFP site. Prior to undertaking actions that may affect potentially suitable habitat, focused surveys will be conducted to determine if sensitive wildlife species are present.

The results of the aforementioned studies that pertain to fauna indicate that habitat potentially suitable for the endangered black-footed ferret (*Mustele nigripes*) is present on the RFP site. Black-footed ferrets require prairie dog colonies or complexes of smaller prairie dog colonies as habitat. Approximately 15 acres, located in the northeast area of the plant site, were identified as a location of a prairie dog colony. These 15 acres are part of a larger colony comprised of an estimated 47 acres that is dissected by Highway 128. This acreage is part of a 753-acre complex that primarily occurs east of Indiana Street. Although the 47-acre colony by itself if insufficient to support black-footed ferrets, the larger complex is potentially suitable habitat for ferrets. This 753-acre complex is fragmented by several major roads and highways. No confirmed sightings have been reported for this area, but several unconfirmed sightings have been reported for the Denver area. Surveys of the 753-acre complex may be required to determine if the 15 acres present on the RFP site is habitat for the black-footed ferret. Surveys will be required only if potential development directly impacts this colony. Based upon the information gathered for this survey, the USFWS is not considering the area of the RFP site as a re-introduction site for black-footed ferrets.

Results of RFP studies also indicate that habitats potentially suitable for the endangered peregrine falcon (*Falco peregrinus*) is present at the RFP site (EG&G, 1991). Although the peregrine falcon was not observed during the reconnaissance level surveys, two historic nest sites are present within 10 miles of the RFP site. The Peregrine Falcon Recovery Plan (USFWS, 1984) discourages land-use practices that would adversely alter the character of their hunting habitat or prey base within a 10-mile radius of a nesting cliff (including historical sites).

2.2.7 Wetlands and Floodplains

The relevant laws and acts which protect wetlands and floodplains include: NEPA, Executive Order (E.O.) 11990 — Protection of Wetlands; Sections 401 and 402 of the CWA; the Fish and Wildlife Act plus associated coordination acts; and regulations promulgated under 10 CFR Part 1022 - DOE Compliance with Floodplain Wetlands Environmental Review Requirements. The rules promulgated under NEPA 42 U.S.C. 4321, et seg., in 40 CFR parts 1500 through 1508 state that all federal agencies are required to consider the environmental effects to wetlands and flood plains of any proposed action (EG&G, 1990b).

Aerial photography imagery for the 903 Pad, Mound, and East Trenches Areas was examined for wetlands identification, followed by limited site inspection (EG&G, 1990b). Two isolated stands of wetlands vegetation containing common cattail (*Typha latifolia*) were located primarily within IHSS 140, where ground water emerges as seeps or springs. The two areas are each less than 20 square feet in size.

Wetlands have been identified along both the Woman Creek and SID drainage areas (EG&G, 1990b). The SID receives surface water runoff from the southern part of the RFP facility with additional contributions from OU 2. Evenly-spaced drop structures along the SID have lowered flow velocities, increased sediment accumulation, and created fairly dense linear stands of wetlands. From a point due south of Building 881 and extending to Pond C-2, approximately 0.15 acres of wetlands are contained within this portion of the SID. Wetland species observed were primarily cattails (greater than 95 percent predominance), spike rush (*Eleocharis macrostachya*) and bullrush (*Scirpus americanus*). The wetlands function primarily as flow attenuation features with additional minor contributions to wildlife habitat and water quality enhancement. Drainage contribution to the SID from OU 2 is minimal.

A detailed floodplain analysis of the Woman Creek Basin is currently being completed by the COE and is expected to be published in the fall of 1991. The preliminary assessment has delineated a narrow 100-year floodplain along the linear channel configuration of Woman Creek estimated to be approximately 100-feet wide. Woman Creek is an intermittent stream flowing primarily in response to precipitation events and interaction between surface water and shallow ground water. Initial site characterization studies completed in 1986 record measurable flow occurrences only at 4 of the 11 gauging stations along the drainage. Flow data for each of the four gauging stations was less than 10 gallons per minute (DOE, 1990).

Each of the proposed surface water collection and treatment alternatives for/a Woman Creek Basin IM/IRA are described in Section 4 along with their anticipated impacts to floodplains and wetlands. This constitutes the floodplains/wetland assessment required by 10 CFR 1022. It should be noted that that same regulation requires DOE to publish in the Federal Register a notice of intent to undertake an action in a floodplain/wetland at least 15 days prior to initiating any construction, if an action alternative is adopted.

2.2.8 Historic and Archeological Sites

NEPA (1969) and the National Historic Preservation Act of 1966 (Public Law 89-665) together with subsequent law amendments (Public Laws 91-243,93-54, 94-422, 94-458) provide that all federal agencies implement programs for the protection of archaeological and historical resources.

The 903 Pad, Mound, and East Trenches Areas have been highly disturbed over the course of a number of years. Due to this disturbance and the topographic position of the subject area, the State Office of Archaeology and Historic Preservation has determined that any action in this vicinity will not impact cultural resources (Burney, 1989). An archaeological and historical survey of the RFP was conducted between July 18, and August 22, 1988, that determined there are no sites at the RFP that have potential eligibility to the National Register of Historic Places. The archeological and historical survey at the RFP is currently being updated and is expected to be published in August 1991.

2.3 CONTAMINANTS — DESCRIPTION AND SOURCES

Soils, ground water, and surface water were sampled and analyzed for radionuclides and for the Hazardous Substance List (HSL) organics and inorganics. In general, soils in the vicinity of IHSSs were found to contain low concentrations of VOCs, and occasionally elevated concentrations of plutonium and americium. Most soil samples contained phthalates, but this may be a result of field or laboratory contamination of the samples. Carbon tetrachloride, tetrachloroethene, and trichloroethene are the primary VOCs found in the upper hydrostratigraphic unit (HSU) [this includes the alluvium and hydraulically interconnected bedrock sandstone (uppermost sandstone)] ground-water flow system at OU 2. Trace elements occurring above background levels in ground water include strontium, barium, copper, and nickel, and to a lesser extent chromium, manganese, selenium, lead, zinc, and molybdenum. Also, major cations and anions and total dissolved solids are somewhat elevated above background throughout and downgradient of the 903 Pad, Mound, and East Trenches Areas. Uranium-238 is the predominant radionuclide occurring above background in the upper HSU ground-water flow system, but a few samples indicate plutonium and americium downgradient of the 903 Pad and possibly north of the Mound (see Section 2.3.5). An evaporative concentration conceptual model has been advanced that may explain high total dissolved solids, metals, and uranium in ground water at OU 2.

Organic contamination is observed in seeps downgradient of the 903 Pad and in the upper reaches of South Walnut Creek at the Mound Area. Also, there are somewhat elevated concentrations of total dissolved solids, major ions, strontium, zinc, and uranium at many of the surface water stations. Seeps downgradient of the 903 Pad also contain plutonium and americium. This is postulated to be due to contaminated suspended solids in the water (see below and Section 2.3.5).

Plutonium and americium occur above background in surface soils. Other radionuclides and trace metals occur at low concentrations and are infrequently above background but may also be soil contaminants at the 903 Pad, Mound, and East Trenches Areas. Data suggest plutonium and americium were released to soils in the area via wind dissemination during clean-up efforts at the 903 Drum Storage Site. These radionuclides occur in surface soils throughout the 903 Pad, Mound, and East Trenches Areas and other downwind areas to the southeast.

The following discussion of contamination of ground water, soils, sediments, and surface water focuses on VOCs, plutonium, and americium because these contaminants are the most important relative to potential health effects, and they are associated with known wastes disposed at OU 2. As discussed above, metals and other organic compounds and radionuclides have been detected in samples from OU 2. However, these constituents are not confirmed site contaminants either because of the infrequent occurrence (spatially and temporarily in the case of surface and ground water) at concentrations above background (i.e., concentrations may actually be within background variations), their potential presence due to laboratory contamination, or their occurrence at elevated concentrations resulting from natural phenomena, e.g., localized evapotranspiration. A goal of the Phase II RFI/RI is to determine if these constituents are site contaminants. The reader is referred to Technical Memorandum 1 (Final Phase II RFI/RI Work Plan) for further details regarding contamination and proposed investigations at OU 2.

2.3.1 Background Characterization

In order to facilitate the interpretation of chemical results in non-background areas, a background characterization program has been implemented to define the spatial and temporal variability of naturally occurring constituents. Field work was conducted in 1989, and a draft Background Geochemical Characterization Report was prepared and submitted to the regulatory agencies on December 15, 1989 (Rockwell International, 1989c). The draft report was updated in December 1990 to include additional rounds of ground-water and surface water samples. The document summarizes the background data for ground water, surface water, sediments, and geologic materials, and identifies preliminary statistical boundaries (tolerance intervals) of background variability. Spatial variations in the chemistry of geologic materials and water were addressed by placing sample locations throughout background areas at the Plant. Evaluation of temporal variations in water chemistry is ongoing.

The information in the Background Geochemical Characterization Report has been used to preliminarily characterize inorganic contamination of surface water at the 903 Pad, Mound, and East Trenches Areas. The surface water tolerance intervals are statistical ranges of the background analyte concentrations in the various media that represent 95 percent of the population with 95 percent confidence. Summary tables of the upper limits of these tolerance intervals are provided in Tables 2-2 through 2-5 for reference. Although the discussion in Section 2.3.5 focuses on plutonium and VOC contamination in the Woman Creek seeps, these background tolerance intervals for surface water are provided to identify all constituents above background in order to establish a framework for characterizing seep water quality and constituent concentrations that are above ARARs (see Section 4.1). Background levels for organic constituents are assumed to be non-detectable.

2.3.2 Ground-Water Contamination

Ground water at the RFP has been monitored since 1986. Wells have been installed throughout the property and are sampled quarterly. Appendix A presents a summary of VOCs as well as plutonium and

TABLE 2-2
STATISTICS FOR TOTAL METAL CONCENTRATIONS IN BACKGROUND SURFACE WATER SAMPLES
(Concentration units mg/l)

	Al	Sb	As	Ba	Be	Cd	Ca	Cs	Cr
Normal or Log Normal*	Log	Normal	Normal	Normal	Normal	Normal	Log	Normal	Normal
Upper Tolerance Limit	60.4235	.	.	.	.	.	106.9661	.	.
Lower Tolerance Limit	.	.	.	.	.	.	.	.	.
Maximum Concentration	293.0	0.5U	1.03	4.49	0.0107	0.644	803.0	2.53	0.275
Minimum Concentration	0.0599	0.06U	0.0020U	0.05U	0.002U	0.004U	13.5	0.1U	0.01U
Cohen or Unrevised	C	UN	UN	UN	UN	UN	UN	UN	UN
Mean	20.9352	0.0499	0.366	0.3942	0.0028	0.0039	71.9915	0.6541	0.0162
Standard Deviation	19.2127	0.0618	0.1535	1.0031	0.0018	0.0088	15.3714	0.4005	0.0407
Sample Size	52	49	55	56	52	51	26	56	48
Percent Detected	65.4	2.0	20.0	23.2	5.8	3.9	100.0	1.8	20.8
Classification Method	A	-	P	P	-	-	A	-	P

	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo
Normal or Log Normal*	Normal	Normal	Log	Normal	Normal	Log	Log	Normal	Normal
Upper Tolerance Limit	.	.	87.1476	.	.	8.9377	1.9654	.	.
Lower Tolerance Limit	.	.	.	.	.	.	.	.	.
Maximum Concentration	0.489	0.607	3220.0	0.516	0.1U	28.5	27.7	0.0014	0.5U
Minimum Concentration	0.02U	0.02U	0.1U	0.002U	0.01U	5.0U	0.01U	0.0002U	0.0105
Cohen or Unrevised	UN	UN	UN	UN	UN	C	C	UN	UN
Mean	0.0357	0.0328	33.0397	0.0370	0.0448	6.9461	0.7601	0.0002	0.0625
Standard Deviation	0.0658	0.0854	26.5529	0.1013	0.0147	0.9774	0.5915	0.0003	0.0575
Sample Size	51	55	56	54	26	56	56	48	56
Percent Detected	5.9	16.4	16.4	31.5	0.0	71.4	76.8	22.9	14.3
Classification Method	-	P	A	P	-	A	A	P	P

DRAFT

TABLE 2-2 (Continued)
STATISTICS FOR TOTAL METAL CONCENTRATIONS IN BACKGROUND SURFACE WATER SAMPLES
(Concentration units mg/l)

	Ni	K	Se	Ag	Na	Sr	Tl	Sn	V	Zn
Normal or Log Normal*	Normal	Normal	Normal	Normal	Log	Normal	Normal	Normal	Normal	Log
Upper Tolerance Limit	.	.	.	.	17.7691	.	.	.	.	0.3765
Lower Tolerance Limit	.	.	.	.	.	.	.	.	.	.
Maximum Concentration	0.646	10.2	0.025U	0.148	30.8	1.46	0.05	0.969	1.65	2.68
Minimum Concentration	0.02U	1.03	0.002U	0.01U	5.0U	0.1U	0.003U	0.1U	0.01U	0.02U
Cohen or Unrevised	UN	UN	UN	UN	UN	UN	UN	UN	UN	C
Mean	0.0394	2.9749	0.0029	0.0093	13.9782	0.3952	0.0063	0.1100	0.0761	0.1903
Standard Deviation	0.0982	1.7053	0.0022	0.0199	1.6661	0.2692	0.0052	0.1808	0.2307	0.0910
Sample Size	46	53	53	54	26	56	54	56	55	54
Percent Detected	6.5	17.0	3.8	7.4	96.2	42.9	0.0	5.4	14.5	75.9
Classification Method	-	P	-	-	A	P	-	-	P	A

* = Normal or log normal data distribution were assumed. All statistics presented are untransformed (antilog) values;
U = Concentration below detection limit;
N = NANOVA;
. = Value not computed;
C = Cohen revised statistics;
UN = Unrevised statistics;
A = Parametric ANOVA;
K = Kruskal-Wallis nonparametric ANOVA;
- = No classification;
P = Test of Proportions.

NOTE: Statistics shown in this table are of general applicability to background surface water at the RFP site; however, statistics for Ca, Li, and Na are specific to the Woman Creek drainage.

TABLE 2-3
STATISTICS FOR DISSOLVED METAL CONCENTRATIONS IN BACKGROUND SURFACE WATER SAMPLES
(Concentration units mg/l)

	Al	Sb	As	Ba	Be	Cd	Ca	Cs	Cr
Normal or Log Normal*	Normal	Normal	Normal	Normal	Normal	Normal	Log	Normal	Normal
Upper Tolerance Limit	.	.	.	.	.	.	39.8803	.	.
Lower Tolerance Limit	.	.	.	.	.	.	.	.	.
Maximum Concentration	0.485	0.5U	0.018	0.211	0.005U	0.005U	78.4	2.5U	0.02U
Minimum Concentration	0.03U	0.06U	0.002U	0.05U	0.002U	0.004U	12.7	0.1U	0.01U
Cohen or Unrevised	UN	UN	UN	UN	UN	UN	UN	UN	UN
Mean	0.1166	0.0473	0.0049	0.0967	0.0024	0.0025	33.7082	0.6421	0.0054
Standard Deviation	0.0827	0.0597	0.0021	0.0247	0.0004	0.0001	2.7310	0.3274	0.0014
Sample Size	48	51	54	57	50	53	27	57	46
Percent Detected	14.6	0.0	1.9	1.8	0.0	0.0	100.0	0.0	0.0
Classification Method	P	-	-	-	-	-	A	-	-

	Co	Cu	Fe	Pb	Li	Mg	Mn	Hg	Mo
Normal or Log Normal*	Normal	Normal	Normal	Normal	Normal	Log	Log	Normal	Normal
Upper Tolerance Limit	.	.	.	.	.	6.4118	0.5096	.	.
Lower Tolerance Limit	.	.	.	.	.	.	.	.	.
Maximum Concentration	0.05U	0.0278	16.7	0.0131	0.1U	27.4	1.1	0.0013	0.5U
Minimum Concentration	0.02U	0.02U	0.1U	0.002U	0.01U	5.0U	0.01U	0.0002U	0.0105
Cohen or Unrevised	UN	UN	UN	UN	UN	C	C	UN	UN
Mean	0.0244	0.0128	0.6777	0.0027	0.0450	4.7569	0.1979	0.0002	0.0611
Standard Deviation	0.0029	0.0028	2.2671	0.0017	0.0144	0.8153	0.1530	0.0002	0.0538
Sample Size	52	56	57	54	27	58	56	49	56
Percent Detected	0.0	3.6	47.4	11.1	0.0	51.7	55.4	14.3	8.9
Classification Method	-	-	P	P	-	A	A	P	P

TABLE 2-3 (Continued)
STATISTICS FOR DISSOLVED METAL CONCENTRATIONS IN BACKGROUND SURFACE WATER SAMPLES
(Concentration units mg/l)

	Ni	K	Se	Ag	Na	Sr	Tl	Sn	V	Zn
Normal or Log Normal*	Normal	Normal	Normal	Normal	Log	Normal	Normal	Normal	Normal	Normal
Upper Tolerance Limit	.	.	.	.	16.3758	.	.	.	.	.
Lower Tolerance Limit	.	.	.	.	.	.	.	.	.	.
Maximum Concentration	0.04U	2.6	0.0124	0.03U	32.3	0.967	0.05U	1.0U	0.05U	0.102
Minimum Concentration	0.02U	1.18	0.002U	0.01U	6.56	0.1U	0.003U	0.1U	0.01U	0.01U
Cohen or Unrevised	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN
Mean	0.0191	2.4649	0.0027	0.0058	13.3162	0.3410	0.0097	0.0810	0.0236	0.0180
Standard Deviation	0.0028	0.1986	0.0017	0.0027	1.3538	0.2010	0.0082	0.1150	0.0052	0.0185
Sample Size	46	51	49	58	27	58	57	58	57	53
Percent Detected	0.0	7.8	4.1	1.7	100.0	43.1	0.0	0.0	0.0	28.3
Classification Method	-	P	-	-	A	P	-	-	-	P

* = Normal or log normal data distribution were assumed. All statistics presented are untransformed (antilog) values;
U = Concentration below detection limit;
M = MANOVA;
. = Value not computed;
C = Cohen revised statistics;
UN = Unrevised statistics;
A = Parametric ANOVA;
K = Kruskal-Wallis nonparametric ANOVA;
\- = No classification;
P = Test of Proportions.

NOTE: Statistics shown in this table are of general applicability to background surface water at the RFP site; however, statistics for Ca, Li, and Na are specific to the Woman Creek drainage.

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TABLE 2-4

STATISTICS FOR INORGANIC CONCENTRATIONS IN BACKGROUND SURFACE WATER SAMPLES
(Concentration units mg/ℓ except pH)

	HCO3	CO3	Cl	CN	Field pH	NO3/NO2	SO4
Normal or Log Normal*	Log	Normal	Log	Normal	Normal	Log	Log
Upper Tolerance Limit	202.1725	.	15.7253	.	9.0230	3.9883	36.9676
Lower Tolerance Limit	.	.	.	.	5.5825	.	.
Maximum Concentration	1900.0	5.0U	62.0	0.0452	9.8	11.0	560.0
Minimum Concentration	30.0	5.0U	3.0U	0.0025U	5.0	0.05U	5.0U
Cohen or Unrevised	UN	UN	UN	UN	UN	C	UN
Mean	166.1012	2.5000	12.6992	0.0046	7.3028	1.5412	29.4620
Standard Deviation	17.8052	0.0000	1.4937	0.0077	0.8580	1.2079	3.7048
Sample Size	59	59	59	56	65	59	59
Percent Detected	100.0	0.0	94.9	7.1	100.0	57.6	91.5
Classification Method	A	-	A	-	A	A	A

* = Normal or log normal data distributions were assumed. All statistics presented are untransformed (antilog) values;
U = Concentration below detection limit;
M = MANOVA;
. = Value not computed;
C = Cohen revised statistics;
UN = UNrevised statistics;
A = Parametric ANOVA;
K = Kruskal-Wallis nonparametric ANOVA;
\- = No classification;
P = Test of Proportions.

TABLE 2-5

STATISTICS FOR TOTAL RADIOCHEMICAL CONCENTRATIONS IN BACKGROUND SURFACE WATER SAMPLES (Concentration units pCi/ℓ)

	Am241	Cs137	Alpha	Beta	Pu239	Ra226	RA228	Sr90	Tritium	U233, 234	U235	U238
Normal or Log Normal*	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal	Normal
Upper Tolerance Limit	0.1769	3.9312	177.4289	163.2045	1.4577	29.2468	64.2265	1.6121	2022.4548	1.1054	0.1863	0.9186
Lower Tolerance Limit	.	.	.	.	.	.	.	.	.	.	.	.
Maximum Concentration	0.372	12.0	440.0	420.0	4.4	30.0	24.0	1.95	980.0	1.51	0.22	1.4
Minimum Concentration	-0.01	-0.6	-2.0	0.0	-0.001	-0.1	-1.1	-0.3	-6930.0	-0.17	-0.17	0.0
Cohen or Unrevised	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN	UN
Mean	0.0265	0.3843	25.5367	24.2510	0.1371	5.4308	11.4750	0.4819	-96.0000	0.3898	0.0206	0.3128
Standard Deviation	0.0717	1.7176	73.3749	67.1246	0.6395	8.9182	10.2552	0.5473	1025.8894	0.3466	0.0802	0.2934
Sample Size	44	50	49	49	50	13	4	50	50	50	50	50
Percent Detected	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Classification Method	KA	KA	A	A	KA	A	A	A	A	A	KA	A

* = Normal or log normal data distributions were assumed. All statistics presented are untransformed (antilog) values;
U = Concentration below detection limit; M = MANOVA; . = Value not computed;
C = Cohen revised statistics;
UN = UNrevised statistics;
A = Parametric ANOVA;
K = Kruskal-Wallis nonparametric ANOVA;
- = No classification;
P = Test of Proportions.

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americium concentrations that are above detection limits in the unconfined ground-water system southeast of the 903 Pad site.

The primary VOCs in ground water (carbon tetrachloride [CCl_4], tetrachloroethene [PCE], and trichloroethene [TCE]) are portrayed by isopleths in Figures 2-9 through 2-11 based on second quarter 1989 data for both unconfined alluvial and bedrock wells. Second quarter 1989 data provide a representative "snapshot" of ground-water contamination at OU 2, i.e., previous and subsequent water quality data show similar patterns of ground-water VOC contamination. The ground-water data (Appendix A) confirm the relative dominance of CCl_4, PCE, and TCE in alluvial and shallow bedrock ground water at OU 2 compared to other VOCs, and documents occurrences of 1,1-dichloroethane (1,1-DCA), 1,1-dichloroethene (1,1-DCE), 1,2-dichloroethene (1,2-DCE), and vinyl chloride (all are possible degradation products of the principal contaminants), and 1,1,1-trichloroethane (1,1,1-TCA), total-1,2-DCE, 2-hexanone, chloroform ($CHCl_3$), methylene chloride, acetone, and carbon disulfide. The latter four analytes were reported at levels below detection limit and therefore represent only estimated values.

The distribution of the principal contaminants suggests that the 903 Pad is the main source of CCl_4, with possible contributions from the northern East Trenches. The Mound Area is the main source of PCE, and TCE occurs throughout OU 2 implying multiple sources. The Phase II RFI/RI Work Plan for OU 2 discusses VOC ground-water contamination in further detail (EG&G, 1990a).

Review of plutonium data (total and dissolved) for ground-water wells east-southeast of the 903 Pad indicates plutonium in ground water is generally at non-detectable levels (error term is greater than the reported value). The highest concentrations of plutonium occurred in well 2-71 (total plutonium = 1.9 ± 1 picoCuries per liter (pCi/ℓ) on 3/11/87 and 32 ± 3 pCi/ℓ in 1988). However, there are three other sampling events showing total plutonium was non-detectable, and the reported value for 1988 is suspect as an exact date for the sample cannot be determined from the documentation. Furthermore, there are seven other sampling/analyses for dissolved plutonium for this well where the radionuclide was non-detectable.

2.3.3 Soil Contamination

The extent of soil contamination at the 903 Pad, Mound, and East Trenches Areas was determined from soil samples collected in 1987 during the Phase I RI (Appendix A). Samples were collected from boreholes drilled in and adjacent to known IHSS locations (Figure 2-12). Two-foot intervals were composited for VOC, and 2- to 10-foot intervals were composited for all other analytes. Boreholes were not drilled into sites still containing wastes (the Trenches and 903 Pad) due to potential health hazards to field workers and potential for release of waste constituents to the environment. The soils data are summarized here because of the potential influences contaminated soils may have on surface water quality. Either direct contributions via overland runoff, or direct influences via ground-water interactions are possible. The discussion is considered preliminary because wastes were not directly sampled and soils data are still being evaluated.

VOCs, including PCE, TCE, toluene, 2-butanone, CCl_4, acetone, and methylene chloride, were reported in samples from the 903 Pad and East Trenches Areas. Occurrences of total xylenes, ethylbenzene and toluene were also reported for the 903 Pad Area, whereas 1-2-dichloroethane (1,2-DCA), 1,1,1-TCA, and 1,1,2-Trichloroethane (1,1,2-TCA) were reported in an East Trenches borehole. The Mound Area soils, like other portions of OU 2, contained acetone (hundreds of micrograms per liter) and methylene chloride (typically tens of micrograms per liter) at concentrations too low to unambiguously demonstrate contamination with these compounds. Other organic constituents in the Mound Area (PCE, $CHCl_3$, 1,2-DCA) were less numerous and at lower levels than at other areas within OU 2.

Plutonium and americium are the principal radionuclide contaminants exhibiting elevated concentrations in soils. Highest concentrations occurred in samples that included the surface. Because many of the surface soil samples were mixed into large composites, the Phase I RI data do not rule out the presence of radionuclides other than plutonium and americium. Cesium-137, tritium, and uranium were detected, albeit at near-background concentrations and in fewer than 10 samples. Surface contamination of soils with plutonium and americium was further demonstrated by a recent aerial radiological survey (EG&G, 1989). The radioactivity detected in that survey was associated with known radioactive material storage and handling areas (i.e., the 903 Pad), and was attributed to plutonium, americium, and a uranium decay product. The survey indicated elevated concentrations of americium in soils east of the 903 Pad Lip Site as high as 97 picoCuries per gram (pCi/g), and by inference from their expected activity ratio, plutonium as high as 500 pCi/g. Subsequent analysis of samples from the area with high americium concentrations indicated plutonium concentrations as high as 457 pCi/g. The cesium-137 activity in the Plant area was at a level consistent with global fallout.

2.3.4 Sediment Contamination

Sediments in Woman Creek and South Walnut Creek were sampled in the fall of 1986, in the spring and fall of 1989, and in the fall and winter of 1990. Stations SED-28, SED-29, and SED-25 are located within the SID in the Woman Creek drainage (Figure 2-13). SED-31 is associated with seep SW-64, and SED-30 is associated with a seep (SW-62) on the SID southern berm. SED-27 and SED-26 are along Woman Creek just upstream of Pond C-2. Stations SED-11, SED-12, and SED-13 are located along South Walnut Creek. SED-11 is the most upgradient station, SED-12 is just upstream of Pond B-1, and SED-13 is just downstream of Pond B-5. Stations SED-1 and SED-2 on Woman Creek and an ephemeral tributary, respectively, are both downstream of OU 2, just west of Indiana Street within the boundary of the buffer zone (east of area depicted by Figure 2-12).

The discussion of sediment contamination will focus on the sediment stations along the SID as data from these stations will provide information on potential impacts from the Woman Creek seeps, although seep flow into the SID is not known to occur. For the purposes of this IM/IRAP, it suffices to say that VOCs and plutonium have been detected at most all sediment stations within OU 2. (The reader is referred to Technical Memorandum 1, the OU 2 Final RFI/RI Work Plan, for additional details.) The most common volatiles detected are methylene chloride and acetone, but these compounds often appear in the associated laboratory blanks and may, therefore, not be representative of sediment contamination. The elevated plutonium concentrations in sediments are presumed to be a result of deposition of wind-blown plutonium-contaminated dust from the 903 Pad Area, as soils throughout this vicinity have elevated plutonium levels and the 903 Pad is a historical source for plutonium.

The chemical data suggest the sediments in the SID are not impacted by the Woman Creek seeps. The principal contaminants in the Woman Creek seeps are CCl_4, PCE, and TCE, and to a lesser extent $CHCl_3$, 1,1,-DCE, and 1,2-DCE, yet these contaminants are generally not present in the sediments along the SID. Chloroform and trichloroethene are present at SED-31; however, this sediment station is associated with the seep at SW-64. TCE was detected at SED-30; however, it occurred at only 7J micrograms per liter ($\mu g/\ell$) and was not present above detection limits in three other samples at this location. With respect to plutonium, this radionuclide appears to increase in concentration in the sediments with downgradient distance along the SID. It is noted that SED-28, where sediment plutonium concentrations are the lowest, is hydraulically upgradient of the point of potential seep flow into the SID. However, because seep flow has not been observed to enter into the SID, and the sediment locations farther downgradient along the SID are closer to the prevailing wind vector from the 903 Pad site, it is more likely the higher plutonium levels are reflective of plutonium-contaminated dust deposition. In general, soils southeast of the 903 Pad site show higher levels of plutonium contamination relative to the surrounding areas.

2.3.5 Surface Water Contamination

Twenty-six surface water and surface seep stations in the vicinity of the 903 Pad, Mound, and East Trenches Areas were sampled during field activities from 1986 through 1990 (see Appendix B). Surface water monitoring locations are shown on Figure 2-13. Flowing surface water in drainages was sampled at stations on the SID and Woman Creek just upstream of Pond C-2, and at stations upstream of the B-series ponds on South Walnut Creek. The surface water seeps are downslope and southeast of the 903 Pad Area, and downslope and north of the Mound Area and East Trenches Areas.

As with the sediment contamination discussion, the assessment of surface water contamination will focus on the seeps southeast of the 903 Pad and the surface water stations along the SID, including Pond C-2.

The seeps are the subject of this plan, and the SID is the potential receptor of seep flow. Also, the contaminant characterization will focus on plutonium and volatile organics, as these are the contaminants of concern. (The reader is referred to Technical Memorandum 1, the Final OU 2 RFI/RI Work Plan, for additional details of contamination in Woman Creek and South Walnut Creek.) It suffices to say here that trace volatile organic contamination occurs in Woman Creek, while the upper reach of South Walnut Creek is unambiguously contaminated with volatiles. It is postulated that in both cases the source of the contamination is discharge of contaminated ground water. A goal of the Phase II RFI/RI is characterization of this interaction. The contamination in the upper reach of South Walnut Creek appears to be a source for low-level volatile organic contamination in Pond B-5, and, accordingly, an objective of the South Walnut Creek IM/IRA is to collect and treat this water.

There are several seeps downslope to the southeast of the 903 Pad. Surface water stations established at these seeps in the 903 Pad Lip Area are designated SW-50, SW-51, SW-52, SW-55, SW-57, SW-58, and SW-77. Station SW-50 is closest to the 903 Pad, and SW-57 and SW-52 are south of SW-50. SW-51 and SW-58 are located in a ditch along the road east of SW-50; however, overland flow of seepage from SW-50, SW-52, and SW-57 will also enter the ditch. Water in the ditch passes under the road south of these locations through a culvert. The discharge of the culvert is sampled at station SW-55. It is noted, therefore, that the discharge at SW-55 represents water from SW-51 and SW-58 which likely receive flow from SW-50, SW-52, and SW-57. SW-77 is another seep located on the east side of the road, just north of SW-55. Farther downgradient stations include seeps hydraulically upgradient of the SID at SW-53, SW-63, and SW-64; seep SW-62 on the southern berm of the SID; and SW-27, SW-30, SW-54, and SW-70 within the SID.

Data for seeps in the vicinity of the 903 Pad Lip Site and farther downgradient at SW-53, SW-63, and SW-64 indicate organic contamination (see Appendix A). The principal organic contaminants in seeps in the vicinity of the 903 Lip Site include 1,1-DCE, $CHCl_3$, 1,2-DCE, CCl_4, TCE, and PCE, with concentrations CCl_4 and TCE exceeding 1,000 $\mu g/\ell$. Frequently, 1,2-DCE is present at SW-53, while detection of other volatile organics is rare. This preponderance of 1,2-DCE at SW-53 is significantly different from the organic contaminants in other seeps east-southeast of the 903 Pad Area, and may reflect a contaminant source at the Mound or East Trenches Areas. Methylene chloride also occasionally occurs in these seeps, at concentrations near the detection limit, however, it also frequently occurs in the laboratory blanks.

Because surface water at seeps represents ground-water discharge, the surface water compositions are similar to those of local ground water. The data for both media show that PCE, TCE, CCl_4, and their degradation products are the principal VOCs, and they show very similar major ion contents as well. The VOC concentrations in the seeps and in well 29-87 suggest that a solvent plume within alluvial ground water is migrating to the southeast, which is consistent with the alluvial ground-water flow direction. It is inferred that

VOC-contaminated alluvial ground water approaches the SID and Woman Creek. Again, the Phase II RFI/RI data will characterize the extent of ground-water contamination and any ground-water/surface water interaction.

Unlike VOCs, plutonium in seeps does not appear to originate from ground water. In general, concentrations of plutonium are significantly higher in seep water than in ground water (see discussion in Section 2.3.2, and Appendix B data summaries). Total plutonium concentrations in ground water are generally non-detectable, whereas total plutonium concentrations in surface water seeps near the 903 Pad are almost always detectable and in a range of 1 to 110 pCi/ℓ. Considering the total suspended solids concentrations in seeps ranges from 4 to 1,000 milligrams per liter (mg/ℓ),and the plutonium concentration in near surface soils in this area is typically on the order of 100 pCi/g (the gamma survey conducted by EG&G indicates maximum concentrations in surface soils of approximately 500 pCi/g), the resulting total plutonium concentrations in seep water would be expected to range from 0.4 to 100 pCi/ℓ (Figure 2-14). These data suggest the plutonium in the surface water seeps arises from plutonium-contaminated surface soils in this area.

The fraction of total plutonium that is dissolved in surface water seeps is highly variable with a range of 1 to 62 percent. Although some of the dissolved plutonium may have originated from ground water, the low concentrations of dissolved plutonium in ground water would indicate the ground water plutonium contribution to surface water seeps is insignificant. Rather, it would appear the observed concentrations of plutonium in the seep are simply a reflection of plutonium-contaminated suspended solids in the samples, and some fraction of the plutonium will pass a 0.45 micro (μ) filter, which is used to define "dissolved."

The seep flow does not appear to be exacerbating plutonium ground-water contamination (if it exists at all) as plutonium has never been detected in well 29-87. Also, the seeps travel only a short distance (less than 30 meters observed for the seep with the greatest flow [SW-55]), and therefore, transport of plutonium-contaminated soil (if it is occurring) is contained in an area of otherwise significant plutonium surface soil contamination.

The volatile organic data support that the Woman Creek seeps are not impacting surface water in the SID or Pond C-2. The most frequently occurring contaminant in surface water of the SID and Pond C-2 is methylene chloride (also a possible lab artifact), with infrequent occurrences of acetone, CCl_4, toluene, 2-butanone, $CHCl_3$, PCE, TCE, and xylenes. In contrast, the Woman Creek seeps are characterized by the frequent presence of CCl_4, PCE, and TCE. The only occurrence of CCl_4, PCE, and TCE in the SID/Pond C-2 drainage system is CCl_4 at SW-30 (7 μg/ℓ; 15 other samples for SW-30 show CCl_4 below detection limits), and PCE and TCE in Pond C-2 at concentrations of 13 μg/ℓ and 15 μg/ℓ, respectively. However, there are 48 other sampling events where these compounds were below detection limits. The VOCs in the Woman Creek seeps are therefore either volatizing or reentering the ground-water flow system upgradient of the SID and Pond C-2.

The plutonium data do not provide an unambiguous indication of impacts of Woman Creek seeps on the SID/Pond C-2 system. At stations SW-70 and SW-30, upstream of potential seep flow discharge to the SID, total and dissolved plutonium concentrations range from undetectable to 0.22 pCi/ℓ, with most concentrations generally < 0.05 pCi/ℓ. At SW-54 and SW-62, stations that could potentially be impacted by the seeps, plutonium concentrations range from undetectable to 3.7 pCi/ℓ, higher than those observed upgradient. However, concentrations of plutonium at farther downgradient stations SW-27 and Pond C-2 are again similar to the upgradient stations (non-detectable to 0.82 pCiℓ, with most concentrations < 0.05 pCi/ℓ). This data renders any judgment regarding impacts from seeps to surface water at SW-54 and SW-62 inconclusive, and generally demonstrates the absence of seep impacts to surface water in the SID and Pond C-2.

2.3.6 Air Contamination

The 903 Pad Area is recognized as the principal source of airborne plutonium contamination at the RFP. An extensive air monitoring network known as the Radioactive Ambient Air Monitoring Program (RAAMP) is maintained at the Plant in order to monitor particulate emissions from the 903 Pad Area and other Plant facilities. Historically, the particulate samplers located immediately east, southeast, and northeast of the 903 Pad, Mound, and East Trenches Areas have shown the highest plutonium concentrations. This finding is corroborated by the results of soil surveys that indicate elevated plutonium concentrations to the east, particularly southeast of the area. However, RAAMP has found ambient air samples for plutonium to be well within the DOE guidelines of 20.0×10^{-6} pCi/ℓ established for the protection of human health (Rockwell International, 1987b).

2.3.7 Summary of Contamination

The Phase I RI investigations of environmental media lead to the general conclusions that volatile organic and radionuclide contamination exists in soils, surface water, and ground water around several OU 2 IHSSs, and that the distribution and magnitude of the contamination can be better delineated via sampling and analysis planned for the Phase II investigation.

TCE, PCE, and CCl_4 are the principal organic contaminants in surface and ground waters, with lesser amounts of their degradation products and other compounds at numerous sampling sites throughout OU 2. Plutonium and americium in surface water samples are other apparent indicators of RFP-derived contamination.

The Woman Creek seeps do not appear to be exacerbating environmental contamination arising from the 903 Pad Area. The chemical data support that the surface water and sediments of the SID, and Pond C-2 water are not impacted by the seeps. The downslope flow of plutonium and VOC contaminated seepage is contained within an area of significant surface soil plutonium contamination and ground-water VOC contamination. Therefore, the existence of the seeps is not resulting in more extensive soil or ground-water contamination in this area. According to OSWER Directive No. 9355.0-30, the need for an interim remedial action should be based, in part, on the presence of contamination, if left unaddressed in the short term, that contributes to degradation of the environment/natural resources. An IRA for the Woman Creek seeps cannot be justified on these grounds.

2.4 ANALYTICAL DATA

Organic, inorganic, and radionuclide contaminants exist in OU 2 surface water. Appendix B of Volume II presents a compilation of volatile organic, inorganic, and radiochemistry data for all Woman Creek drainage surface water stations at OU 2 that are available at this time. Some of the data have been validated; they are identified in the appendices by a qualifier adjacent to each datum. The qualifiers "V" (valid), "A" (acceptable with qualifications), and "R" (rejected) are assigned in accordance with the ER Program Quality Assurance/Quality Control (QA/QC) Plan (Rockwell International, 1989b). Rejected data either did not conform to the QA/QC procedures, or insufficient documentation exits to demonstrate conformance with these procedures. These data, at best, can only be considered qualitative measures of the analyte concentrations. The schedule for the IM/IRA does not permit waiting for all data to be validated. However, the validated data and their similarity to unvalidated data are considered sufficient for this IM/IRAP/EA.

SECTION 3

IDENTIFICATION OF INTERIM REMEDIAL ACTION OBJECTIVES

3.1 OBJECTIVES OF INTERIM MEASURES/INTERIM REMEDIAL ACTION PLAN

The objectives of the Woman Creek Basin IM/IRAP at OU 2 are to assess human health and environmental risks resulting from the presence of contaminated Woman Creek Basin seeps, and to identify and evaluate alternatives for collection and treatment of the seepage. The interim remedial measures comprise alternatives for the collection and treatment of contaminated surface water to achieve, to the extent practicable, ARARs (see Section 3.3). ARARs are used in defining the remediation goals for an IM/IRA. Based on meetings between DOE, CDH, and EPA during February and March 1990, specific point source locations for the collection of contaminated Woman Creek seepage were identified, and it was agreed that the design flows would be exclusive of those resulting from high precipitation events. The design flows for the alternative treatment systems is the maximum observed flow at each seep targeted for collection (see Section 4.1.1.1).

3.2 SCHEDULE

Revisions to this plan based on public comment, and preparation of a Responsiveness Summary pursuant to the public meeting, will occur through the Winter of 1991-1992. Milestone dates for specific activities are presented in Table D-1, Appendix D.

3.3 COMPLIANCE WITH ARARs AND PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The NCP [FR Vol 55, No. 46, 8848; 40 CFR 300.430 (e)] requires that, in development of remediation goals, the following be considered:

1. ARARs.
2. For systemic contaminants, concentration levels that will not cause adverse effects to the human population and sensitive subgroups over a lifetime of exposure.
3. For carcinogens, exposure levels represent an upper bound lifetime cancer risk between 10^{-4} and 10^{-6}. The 10^{-6} risk level is to be used as a point of departure when ARARs are not available or are not sufficiently protective because of multiple contaminants or multiple exposure pathways.
4. Factors related to detection limits.
5. For current or potential sources of drinking water, attainment of Maximum Contaminant Level Goals (MCLGs) or Maximum Contaminant Levels (MCLs), if MCLGs are zero.
6. Attainment of CWA ambient water quality criteria (AWQC), where relevant and appropriate.

The IAG, in paragraph 150, states "Interim Remedial Actions/Interim Measures shall, to the greatest extent practicable, attain ARARs." Also for interim actions, the NCP [40 CFR 300.430(f)] specifically notes that an ARAR can be waived if the action is to become part of the final remedy that will attain ARARs.

This section identifies and analyzes ARARs relevant to proposed Woman Creek Basin IM/IRAs. Because a remedial action would be considered an on-site IM/IRA to be administered under CERCLA, only substantive and not administrative requirements of regulations (such as RCRA) apply. Permits, for example, are not required (per paragraph 121 of the IAG).

3.3.1 Applicable or Relevant and Appropriate Requirements

"Applicable requirements," as defined in 40 CFR 300.5, mean "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable." "Relevant and appropriate requirements," also defined in 40 CFR 300.5, mean "those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws, that, while not 'applicable' to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate." According to CERCLA §121(d)(2), in order to be considered an ARAR, a state requirement must have "promulgated." As defined in 40 CFR 300.400(g)(4) of the NCP, the term "promulgated" means that the requirement is of general applicability and is legally enforceable.

3.3.2 Items To Be Considered

In addition to ARARs, advisories, criteria, or guidance may be identified as to be considered (TBC) for a particular release. As defined in 40 CFR 300.400(g)(3), the TBC category consists of advisories, criteria, or guidance developed by EPA, other federal agencies, or states that may be useful in developing remedies. Use of TBCs is discretionary rather than mandatory as is the case with ARARs.

3.3.3 ARAR Categories

In general, there are three categories of ARARs. These categories are:

- Ambient or chemical-specific requirements.
- Location-specific requirements.
- Performance, design, or other action-specific requirements.

Each category is discussed in more detail below.

3.4 AMBIENT OR CHEMICAL-SPECIFIC REQUIREMENTS

Ambient or chemical-specific requirements set health- or risk-based concentration limits in various environmental media for specific hazardous substances or pollutants. These requirements set protective clean-up levels for the chemicals of concern in the designated media, or may act as action-related requirements in indicating a safe level of air emission or wastewater discharge. The chemical-specific ARARs identified herein are used in defining the remediation goals for cleanup of contaminated surface water and discharge of treated water.

ARARs are derived primarily from federal and state health and environmental statutes and regulations. Where background concentrations for constituents are above the ARAR for that constituent, a waiver from the ARAR may be appropriate. A summary of ARARs for the contaminants found to exceed background in Woman Creek Basin surface water at OU 2 are presented in Appendix E, Table E-1. Table E-1 presents ARARs for volatile organics, metals, conventional pollutants, and radionuclides and will be applied as effluent standards for surface water treatment effluent. TBCs have been identified in Table E-1 where ARARs could not be found, and would be used as goals for surface water treatment.

As discussed in 55 FR 8741 (Preamble to the NCP), when more than one ARAR exists for a contaminant, the most stringent standard has been identified as the ARAR which an IM/IRA would attain to the greatest extent practicable. Where no ARAR standard can be found, a TBC standard has been identified which an IM/IRA would treat as a goal to achieve. Federal and state ARAR spreadsheets used in the ARAR analysis for volatile organics, metals, conventional pollutants, and radionuclides are presented in Tables E-2.1 and E-2.2, Appendix E. The standards identified as chemical-specific ARARs in Table E-1, Appendix E, are based on the most stringent standards found in the Safe Drinking Water Act (SDWA) MCLs and the Colorado Water Quality Control Commission (WQCC) statewide surface water standards. As described in Sections 3.4.1 through 3.4.5, the standards mentioned above were found to be applicable or relevant and appropriate to RFP Woman Creek Basin surface waters.

The standards and criteria identified as TBC in Table E-1 are based on the most stringent standards found in RCRA 40 CFR Part 265, Subpart F, WQCC Site-Specific Surface Water Standards, the criteria in

Tables I, II, and III of 3.1.16 in the Basic Standards for Surface Water, and the WQCC Ground-Water, Human Health, and Agricultural Standards. Additionally, CWA AWQC were applied whenever ARARs or more appropriate TBCs were not identified. TBC standards were identified in Table E-1 only when no ARAR standards were found.

Of the elements/compounds detected in Woman Creek Basin surface water at OU 2, there are no ARARs for calcium, magnesium, sodium, and bicarbonate. However, the Total Dissolved Solids (TDS) ARAR establishes the acceptable aggregate concentration for the above major ions.

As presented in Tables E-2.1 and E-2.2, the ARARs and TBCs summarized in Table E-1 were developed using the ARARs rationale described above and were identified by examining the following standards and criteria:

- SDWA MCLs.
- RCRA 40 CFR Part 264 Subpart F Concentration Limits.
- Colorado WQCC Standards for Surface Water.
- Colorado WQCC Standards for Ground Water.
- CWA AWQC.

3.4.1 Safe Drinking Water Act MCLs

SDWA MCLs represent the maximum permissible level of a contaminant in water that is delivered to the free-flowing outlet of the ultimate user of a public water system [40 CFR 141.2(c)]. Because water in the Woman Creek Basin is a potential source of drinking water, MCLs are relevant and appropriate. Furthermore, the NCP [40 CFR 300.430(e)] requires that, in development of remediation goals for evaluating alternatives for final remediation of current or potential sources of drinking water, attainment of MCLGs or MCLs, if MCLGs are zero, should be considered where relevant and appropriate. As surface water at OU 2 is a potential source of drinking water, the MCLGs (or MCLs) are relevant and appropriate and should be attained (note: the MCLGs are currently zero or equal to the MCLs). It should be noted that on January 30, 1991, and June 7, 1991, (56 FR 3526 and 56 FR 26460, respectively) EPA published final rules amending MCLs and MCLGs for a number of the constituents identified in Table E-1: these standards are effective July 30, 1992, and November 6, 1991, respectively, and will be regarded as relevant and appropriate at that time. For purposes of this document, the new MCLs (MCLGs are zero or equal to the MCLs, except in the case of copper), are, therefore, proposed TBC and are identified as such in Table E-1.

3.4.2 RCRA Ground-Water Protection Standards

Owners or operators of facilities that treat, store, or dispose of hazardous waste must ensure that hazardous constituents listed in 6 CCR (Colorado Code of Regulations) 1007-3 and 40 CFR 261, Appendix VIII, in the ground water from a regulated unit do not exceed concentration limits under 6 CCR 1007-3 and 40 CFR 264.94 in the uppermost aquifer underlying the waste management area beyond the point of compliance. The concentration limits include standards for 14 compounds, with background[1] or alternate concentration limits (ACLs), used as the standard for the other RCRA Appendix VIII constituents. These concentration limits apply to RCRA-regulated units subject to permitting (landfills, surface impoundments, waste piles, and land treatment units) that received RCRA hazardous waste after July 26, 1982. Although this area does not contain RCRA-regulated hazardous waste management units, it does contain IHSSs. As a result, these RCRA (Subpart F) regulations are considered relevant and appropriate for ground-water remediation. However, these requirements are not applicable or relevant and appropriate with respect to the proposed IRAP in that they do not specifically address the treatment and discharge of surface waters, nor are these activities sufficiently similar to the circumstances regulated by the RCRA Subpart F requirements to be relevant and appropriate. RCRA ground-water protection requirements relate specifically to protection against degradation of the uppermost aquifer by a regulated unit, or a solid waste management unit (SWMU) in the case of Corrective Action activities, which clearly do not relate to the collection, treatment, and discharge of surface water, even if surface water is ground-water discharge at seeps. The RCRA ground-water requirements do provide an effective mechanism for the protection of the uppermost aquifer and, consequently, potential drinking water sources. Accordingly, as a conservative measure, since effluent discharges could potentially affect downstream drinking water sources, the Subpart F requirements have been included as TBC for surface water. Background concentrations for 40 CFR 264, Appendix IX constituents not listed in Appendix VIII have also been applied as TBC for surface water.

3.4.3 Colorado WQCC Standards for Surface Water

The Colorado WQCC has established both statewide and stream segment-specific standards for the protection of state surface waters. Statewide standards exist for certain radioactive isotopes and organic compounds, and have been adopted for all state sources of drinking water and areas requiring protection of aquatic life (see Section 3.1.11, 5 CCR 1002-8). These standards are consequently of general applicability. The statewide standards are enforceable through the state's NPDES permitting process. Having met the NCP state ARAR requirements of enforceability and general applicability [40 CFR 300.400(g)(4)], the statewide surface water standards have been applied as ARAR in Table E-1.

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[1] TBC background surface water values for RCRA Subpart F are applied using maximum concentrations from background surface water at RFP.

Site-specific surface water standards also exist for certain organics, metals, inorganics, and radioactive constituents. Unlike the WQCC statewide standards discussed above, these site-specific standards do not appear to satisfy the NCP requirements for state ARARs. While these standards are enforceable through the NPDES permitting process, they have been adopted only for surface waters at the RFP and so are not of general applicability. Also, the site-specific organic standards are based almost entirely on CWA AWQC for water and fish ingestion. These standards have not been applied to the surface waters of the State of Colorado and, in fact, have only been applied to the Rocky Flats Plant. Furthermore, the site-specific standards for radioactive constituents are significantly more stringent than any standards applied to other Colorado surface waters. Consequently, the site-specific organic chemical and radionuclide surface water standards are not ARAR. These standards have been applied as TBC in Table E-1 because they reflect the degree of protectiveness determined to be necessary for the RFP surface waters by the Colorado WQCC.

3.4.4 Colorado WQCC Standards for Ground Water

Although established for ground water and therefore not ARAR for this IM/IRAP, the Colorado WQCC has adopted ground-water protection standards for human health and agricultural uses. These standards are worthy of consideration relative to surface waters since they often provide useful guidance for some parameters, for which surface water standards may not exist. Accordingly, the human health and agricultural ground-water standards have been identified in Appendix E in Table E-2.2 as useful references.

3.4.5 CWA Ambient Water Quality Criteria

The CWA AWQC are non-enforceable guidance developed under CWA Section 304, and are used by states in conjunction with designated stream segment usages to establish water quality standards for the protection of aquatic life and for the protection of human health. Standards include those established for drinking water and fish consumption, fish consumption only, as well as standards for the protection of aquatic life. CERCLA Section 121(d) requires that CWA AWQC be considered in the development of remediation goals in the FS process, where relevant and appropriate. (Use of "relevant and appropriate" here does not refer to ARARs). Relative to this IM/IRAP, AWQC may be considered relevant and appropriate when remediation goals are developed but they are not considered ARAR as they represent non-enforceable guidance. Since the WQCC has designated RFP surface waters as drinking water usage and aquatic life protection stream reaches, the AWQC for Fish and Water Ingestion were used in Table E-1 as TBC.

3.4.6 Protection of Human Health and the Environment

As illustrated by the hazard quotients and carcinogenic risks listed in Tables E-1, achieving the ARARs should result in a clean-up action that is protective of human health and the environment. For non-carcinogens, the protectiveness goal is an HI of 1. The HI is the sum of the hazard quotients (i.e., the estimated daily intake [dose] to reference dose ratios) for all of the contaminants combined, which have been computed and are presented in Table E-1. In assessing non-carcinogenic risk, a hazard index of 1 or less is considered to be acceptable. If the HI exceeds 1, it indicates that there might be the potential for adverse non-carcinogenic health effects occurring. Unlike the method used to evaluate the potential for carcinogenic toxicity, the hazard index does not indicate the probability of adverse health effects occurring, but it is used as a benchmark for determining where there is a potential concern. With respect to carcinogens, cumulative cancer risk should be less than 10^{-4} (individual cancer risks shown in Table E-1 are considered additive). As noted in Table E-1, the calculated incremental cancer risk exceeds 10^{-4} for total uranium. However, for an IRA, by removing this contaminant to the level identified as ARAR in Table E-1, an IM/IRA would be considered protective of human health and the environment.

3.5 LOCATION-SPECIFIC REQUIREMENTS

Location-specific ARARs are limits placed on the concentration of hazardous substances or the conduct of activities solely because they occur in certain locations. These may restrict or preclude certain remedial actions or may apply only to certain portions of a site. Examples of location-specific ARARs which pertain to the IM/IRA are federal and state siting laws for hazardous waste facilities (40 CFR 264.18, fault zone and floodplain restrictions), and federal regulations requiring that actions minimize or avoid adverse effects to wetlands (40 CFR Part 6 Appendix A and 40 CFR Parts 230-231).

More specifically, in addition to the requirements described above, pertinent location-specific ARARs include: Colorado requirements for siting of hazardous waste facilities and wastewater treatment facilities (Colorado Revised Statute 25-15-101, 203, 208, 302 and 25-8-292, 702, respectively); National Historic Preservation Act requirements for preservation of significant articles and historic properties (36 CFR Parts 65 and 800, respectively); federal critical habitat protection requirements (50 CFR Parts 200, 402 and 33 CFR Parts 320-330); and federal requirements for the protection of fish and wildlife resources (40 CFR 6.302).

A summary of location-specific ARARs which an IM/IRA would attain to the greatest extent practicable is presented in Table E-5.

3.6 PERFORMANCE, DESIGN, OR OTHER ACTION-SPECIFIC REQUIREMENTS

Performance, design, or other action-specific requirements set controls or restrictions on particular kinds of activities related to management of hazardous substances or pollutants. These requirements are not triggered by the specific chemicals present at a site, but rather by the particular IM/IRA alternatives that are evaluated as part of this plan. Action-specific ARARs are technology-based performance standards, such as the Best Available Technology (BAT) standard of the Federal Water Pollution Control Act. Other examples include RCRA treatment, storage, and disposal standards, and CWA pretreatment standards for discharges to publicly-owned treatment works (POTWs). RCRA land disposal restrictions (LDRs) for certain contaminants [40 CFR Part 268.40] are also action-specific ARARs for the disposal of secondary wastes generated during water treatment. Action-specific ARARs, which an IM/IRA would attain to the greatest extent practicable, are included in Table E-4. Table E-3 presents RCRA LDRs which are potentially ARAR for placement or land disposal involving non-effluent wastes (e.g., treatment sludges, excavated soils, used treatment materials) if they may be determined to contain hazardous wastes. LDR requirements may be relevant and appropriate for wastes that are not hazardous wastes, as defined in 40 CFR, Part 261, but do contain hazardous substances.

As explained in the NCP (see 55 FR 8666), OSHA requirements for worker protection in hazardous waste operations and emergency response (29 CFR 1910.120) are applicable to workers involved in hazardous substance-related activities, as well as other OSHA requirements related to specific circumstances or activities. These requirements must be satisfied, even though the requirements are not environmental in nature, and therefore are not considered ARARs.

SECTION 4

IDENTIFICATION AND ANALYSIS OF IM/IRA ALTERNATIVES

4.1 WOMAN CREEK BASIN SURFACE WATER IM/IRA ALTERNATIVES

This section identifies and evaluates five Woman Creek Basin surface water IM/IRA alternatives. The five alternatives include the "No Action Alternative" and four surface water collection and treatment alternatives. Each of the four "action" alternatives is comprised of a common surface water collection technology and several surface water treatment technologies or processes. The IM/IRA alternative surface water collection and treatment technologies are introduced in Sections 4.1.1 and 4.1.2, respectively. Section 4.2 describes the process for evaluating the "No Action Alternative" and the four collection and treatment alternatives in a manner that integrates the requirements of CERCLA and NEPA, streamlining the analysis process by combining two sets of criteria (those of CERCLA and those of NEPA) into a single review. Section 4.3 presents a detailed assessment of the No Action Alternative. Sections 4.4 through 4.7 provide detailed descriptions and evaluations of each of the four IM/IRA surface water collection and treatment alternatives.

Descriptions of the surface water collection and treatment alternatives presented in Sections 4.4 through 4.7 are conceptual with only enough detail to allow assessment with respect to CERCLA/NEPA evaluation criteria. Detailed specification and costing for a surface water collection and treatment alternative selected for implementation would be conducted during a design/build phase of the project. The comparative cost evaluations presented here employ a standard 30-year basis for present worth analysis. However, the actual service life of a surface water collection and treatment system implemented for the Woman Creek Basin Surface Water IM/IRA is not known at this time. A system could, for example, become part of the long-term OU 2 remedial action. Lastly, all solid waste generated during the IM/IRA (e.g., filter cake, excavated soils from installation of the surface water diversion and collection structures, and sediments accumulating in the collection system during operation) would be characterized and handled according to the RFP waste management operating procedures. For costing purposes, however, it is assumed that these wastes would be handled and disposed of as low-level mixed wastes.

4.1.1 Surface Water Collection

Figure 4-1 illustrates the locations of the surface water seeps and in-stream monitoring stations within the Woman Creek Basin at OU 2. As mentioned in Section 1.0, general agreement between EPA, CDH, and DOE was reached on the locations for collection of contaminated seep water that should be considered in planning OU 2 surface water IM/IRAs. It was farther agreed that design flows would be maximum observed flows exclusive of those resulting from high precipitation events. The Woman Creek seeps targeted for collection are designated in Figure 4-2 as the IM/IRA Surface Water Monitoring Stations and include 903 Pad and Lip Area seeps SW-50, SW-51, SW-52, SW-55, SW-57, SW-58, and SW-77; and SW-53. Surface water at the IM/IRA monitoring stations exhibit organic and radionuclide contamination. It was agreed that flows at these stations would be collected either at the stations or immediately downstream at a point of confluence. As illustrated by the topographic contour lines in Figures 4-1 and 4-2, waters from the IM/IRA seeps flow southeasterly toward the SID. However, field observations of seep flows suggest that the IM/IRA seeps do not reach the SID. Rather, they extend on the surface only short distances downgradient of the sources prior to re-infiltration into the soil and/or evaporating.

At the meetings between the DOE and the regulatory agencies in February and March 1990, seeps SW-63 and SW-64 were also targeted for collection. These seeps are located in the Woman Creek Basin just north of the SID as shown in Figure 4-1. Limited analytical data for SW-63 and SW-64 (Appendices B and C) suggest the potential presence of $CHCl_3$, TCE, and plutonium (total) above ARARs. However, at the time, field data with respect to flows at SW-63 and SW-64 were not discussed. Of particular note is the observation of a no-flow situation at these seeps for every sampling event. For SW-63, the Appendix B data tables indicate that this seep was completely dry (i.e., "DRY" data entry) for 11 of the 12 attempts at sampling. Although field records for the 24 July 1987 sampling event were not available for review, the Appendix B metals and radionuclide data tables indicate that there may have been an insufficient volume of water at SW-63 to obtain samples for these analyses (i.e., no data reported), which would imply a no-flow condition. Likewise for SW-64, Appendix B data tables list a dry condition for 8 of the 12 sampling events. Review of the field sampling program logbooks indicate that the 22 May 1988, and 27 June 1989 samples were obtained from standing water at the seep. A no-flow condition at SW-64 on 22 July 1987 can also be assumed based on the same rationale presented above for interpretation of SW-63 analytical data reported for the 24 July 1987 sampling event. SW-64 seep flow information corresponding to the 06 December 1990 sampling event was not available at the time of this writing.

The historical observations of dry or "standing water only" conditions at SW-63 and SW-64 suggest that any future flows observed at these seeps are expected to be nominal and seasonal in nature. The benefit of collecting these flows, with respect to mitigating downgradient contaminant migration in surface water, is marginal relative to collection of the other seep flows. In addition, the potential impacts to the environment from installation of surface water collection systems at SW-63 and SW-64 (e.g., downgradient contaminant dispersion from disturbed soils) would appear to outweigh any benefits of collecting and treating this seepage. Therefore, collection and treatment of seep flows from SW-63 and SW-64 has been eliminated from consideration in this Woman Creek Basin Surface Water IM/IRAP/EA.

TABLE 4-2

COMPARISON OF AVERAGE POND C-2 CONCENTRATIONS TO BACKGROUND AND ARARs*

Contaminant	Pond C-2	Background	ARAR/TBC
Volatile Organics ($\mu g/\ell$)			
2-Butanone	5.1	10U	10U**
Tetrachloroethene	2.6	5U	10
Toluene	2.4	5U	2,420
Total Xylenes	2.6	5U	10,000**
Trichloroethene	2.7	5U	5
1,1-Dichloroethene	ND	5U	7
Acetone	5.6	10U	10U**
Methylene Chloride	3.95	10U	5U**
Benzene	ND	5U	5
Carbon Disulfide	ND	5U	5U**
Carbon Tetrachloride	ND	5U	5
Chloroform	ND	5U	100
Vinyl Chloride	ND	10U	2
Metals (mg/ℓ)			
Calcium	33	106	NS
Magnesium	10	9	NS
Zinc	0.155	0.376	0.045**
Sodium	34.56	18	NS
Radionuclides (pCi/ℓ)			
Gross Alpha	4.248	177.4	15
Gross Beta	7.567	163.2	5**
Plutonium-239	0.021	1.458	15
Americium-241	0.006	0.177	0.05**
Uranium$^{(total)}$	2.089	2.2	40

* Constituents listed occurred above background in at least one sample from the seeps. Averages are computed using half the detection limit when constituent was not detected.

** TBC

(Public Law 93-0205), the CWA as amended, and the Migratory Bird Treaty Act (16 V.S.C. 1701-1711) and DOE Order 5400.5. Related guidance includes: DOE, 1988, Environmental Guidance Program Reference Book; ESA and the FWCA, U.S. DOE, Washington, D.C.

Terrestrial populations that may be negatively impacted by excavation and construction of the Woman Creek surface water collection and treatment facilities include vegetation, ground-dwelling rodents, reptiles, and invertebrates. However, none of these terrestrial populations is threatened or endangered, and they can be expected to quickly re-establish their populations in the disturbed areas. Furthermore, any loss of vegetation could be offset somewhat by reseeding disturbed areas with native grass and shrub species. Therefore, impacts to terrestrial ecosystems from surface water collection and treatment systems will not be further discussed in subsequent sections.

The nearest point of aquatic life that may be affected by the collection and treatment of Woman Creek seeps is Pond C-2. Pond C-2 supports a small population of aquatic biota including redside dace minnows, bluegill, and periphyton.

Potential negative impacts on aquatic biota in Pond C-2 may result from construction and installation of surface water collection and treatment facilities. Physical disturbance during excavation and construction activities could result in increased rill and sheet erosion ending in the SID. However, erosion control methods will greatly reduce the potential for this surface water transport of contaminants. Vegetation within the SID will also intercept suspended particles and minimize the sediment load entering Pond C-2, reducing potential impacts to aquatic biota. Because Alternative No. 4 involves discharge of heated water, further discussion on impacts to aquatic biota from surface water collection and treatment will only be included in Section 4.7.4.2.

4.2.3.4 Threatened and Endangered Species

Representative laws and regulations which protect threatened and endangered species include: the NEPA of 1969, the ESA of 1973, the CWA as amended, and the Migratory Bird Treaty Act. Federal agencies must ensure that actions authorized, funded, or carried out by them will not jeopardize the continued existence of any endangered or threatened species (EG&G, 1991). Section 7(a)(2) of the ESA requires federal agencies "in consultation with and with the assistance of the Secretaries of the Interior and Commerce, to ensure that their actions are not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction of adverse modification of the critical habitat of such species... ." The statutory authority is listed as follows: Section 7 of the ESA of 1973 (16 U.S.C. 1536), P.L. 93-205, December 28, 1973; as amended by P.L. 95-632, P.L. 96-159, and P.L. 97-304. Authority to conduct consultations has been delegated by the Secretary of the Interior to the Director of the USFWS. The USFWS has authority over endangered or threatened species and their critical habitats as listed in 50 CFR 17.

Related guidance implementation includes the following:

50 CFR Part 17 — Endangered and Threatened Wildlife and Plants (includes critical habitats).

50 CFR Part 225 — Federal/State Cooperation in the Conservation of Endangered and Threatened Species.

50 CFR Part 402 — Interagency Cooperation.

Environmental Guidance Program Reference Book. U.S. Department of Energy, 1988.

Endangered Species Act, and the Fish and Wildlife Coordination Act, U.S. DOE, Washington, D.C.

The construction (excavation and installation) of surface water collection systems SW-55 and SW-53 in the Woman Creek Basin will not effect potential habitat suited for threatened and endangered species. Although there are three endangered species of interest in the RFP area, there is no critical habitat present for these species in the Woman Creek Basin. The three endangered species of interest in the RFP area are the black-footed ferret (*Mustele nigripes*) (USFWS, 1988), the peregrine falcon (*Falco peregrinus*), and the bald eagle (*Haliaeetus leucociphalus*) (EG&G, 1991).

Prairie dog colonies in the northeast area of the plant site provide the potential food source and habitat for the black-footed ferrets. However, no prairie dog towns exist in or near the seeps so black-footed ferrets are likely not to exist in this area (DOE, 1990).

Peregrine falcons were not observed during the reconnaissance-level surveys for the threatened and endangered species evaluation (EG&G, 1991), although two historic nest sites are located within 10 miles of the RFP site. The Peregrine Falcon Recovery Plan (USFWS, 1984) discourages land-use practices that would adversely alter the character of their hunting habitat or prey base within a 10-mile radius of a nest cliff (including historical sites). Because peregrine falcons prey exclusively waterfowl and other birds, construction and installation of the collection systems for the Woman Creek Basin will not effect the hunting habitat or the prey base for the peregrine falcon.

Although bald eagles (*Haliaeetus leucocephalus*) are identified as occasionally using habitat between 0.3 and 1.1 miles from the RFP site during the winter months, sightings are rare and little suitable habitat occurs. No bald eagle nests occur on plant site (DOE, 1990).

Based on the above discussion, further consideration of impacts to threatened and endangered species for the Woman Creek Basin IM/IRA is not warranted and is not included in subsequent sections.

4.2.3.5 Historic and Archeological Sites

NEPA (1969) and the National Historic Preservation of 1966 (Public Law 89-665), together with subsequent law amendments (Public Laws 91-243, 93-54, 94-422, 94-458), provide that all federal agencies implement programs for the protection of historical and archeological resources. Section 106 of the National Historic Preservation Act requires federal agencies to consider the effects of the proposed actions on properties eligible for or listed on the National Register of Historic Places. Section 110(f) of the National Historic Preservation Act requires specifications in federal agency's actions to minimize harm and adverse effects to National Historic Landmarks. Regulatory guidance procedures include the following:

36 CFR 800 – Protection of Historic and Cultural Properties (51 FR 31118-31125, September 2, 1986).

Environmental Guidance Program Reference Book. Historic Preservation Requirements. U.S. Department of Energy, 1987. U.S. DOE, Washington, D.C.

Guidelines for Federal Agency Responsibilities under Section 110 of the National Historic Preservation Act (53 FR 4727-4746, February 17, 1988). National Park Service.

National Register of Historic Places (published by the National Park Service at various times in the Federal Register) (reference to these listings is in DOE. 1987).

Advisory Council on Historic Preservation, 1986. Section 1206, Step-by-step.

National Register Bulletins issues periodically by the National Park Service.

Compliance with Section 106 requires federal agencies to identify and evaluate historic properties. The RSO (DOE Order 5440.1c) and the State Historic Preservation Officer locate and evaluate the eligibility of possible historic properties for the National Register of Historic Places. The historic and archeological survey of the RFP is currently being updated with results to be published in August of 1991. Preliminary results show that there are no sites at the RFP that have potential eligibility for the National Register of Historic Places. Therefore, further discussion of historic and archeological sites is not included in subsequent sections.

4.2.3.6 Short- and Long-Term Land Productivity

Land within OU 2 is currently undeveloped and will remain so for the foreseeable future as part of the Rocky Flats Plant. OU 2 lies within the Rocky Flats security boundaries and is not accessible to the general public. Therefore, further discussion of short- and long-term land productivity is not included in subsequent sections.

4.2.3.7 Personnel Exposures

DOE NEPA documentation includes analysis of potentially significant occupational impacts to workers and the public. This analysis includes radiological and nonradiological impacts under routine and accident conditions. Analysis of accidents includes potential impacts to workers as a result of an accident, and potential impacts associated with clean-up activities.

When analyzing occupational impacts, credit was taken for worker protection provided by the Environmental Restoration's Health and Safety Program Plan (ERHSPP). The ERHSPP addresses the minimum health and safety requirements for outside contractors as dictated by the ER Department and the Health Safety (HS) Department. The ERHSPP outlines the requirements for a project-specific or Site Specific Health and Safety Plan (SSHSP) that identifies construction tasks, potential hazards and the steps to control hazards. The SSHSP would be prepared in accordance with guidelines set forth in the ERHSPP, and the Plan for Prevention of Contaminant Dispersion (PPCD), and would be completed after an IM/IRA design is finalized. The SSHSP must be approved by the ER and HS Departments, and will be reviewed by EPA and CDH. Worker protection is also provided by the Occupational Safety Analysis (OSA) procedures. The OSA addresses health and safety concerns originating from routine site operations.

The effects of personnel exposures to hazardous chemicals from the surface water collection and treatment systems has been estimated in terms of increased risks of either developing cancer (carcinogenic risk) or some other adverse health effect (noncarcinogenic risk) due to the exposure. Analyses were done separately for those directly involved in remedial actions (workers), other RFP personnel not directly involved in remedial actions (site employees), and off-site individuals (general public). Detailed risk assessment calculations are provided in Appendix H.

The risk assessment for carcinogenic and noncarcinogenic effects for hazardous and radioactive materials was performed in accordance with the EPA's Risk Assessment Guidance for Superfund Sites (EPA, 1989). Noncarcinogenic risks are considered "threshold" events. The potential for increased health effects is expressed in terms of the noncancer hazard index (HI). EPA methodology assumes that an index value of less than one is unlikely to result in adverse health effects, even for sensitive population groups.

The intake of radioactive materials has been assessed by calculating total intake by individuals and converting that to Committed Effective Dose Equivalent (CEDE) using the exposure-to-dose conversion factors for inhalation (Table 2.1 of EPA, 1988). The calculated doses are then compared with the applicable DOE limits for each receptor group. DOE Order 5480.11 (DOE, 1988b) establishes a limit of 5 radiation equivalent man (rem) (effective dose equivalent) per year for occupational workers. DOE Order 5400.5 (DOE, 1990b) incorporates a CAA limit of 10 mrem (effective dose equivalent) per year for members of the public from routine airborne emissions and a dose limit of 100 mrem per year from all exposure modes.

4.2.3.8 Commitment of Resources

Commitment of Resources is evaluated by examining the economic and ecological value of materials (and labor) required for the IM/IRA alternatives. The resources (including both material and labor) required for construction and operation of the action alternatives for this Woman Creek Basin IM/IRA are relatively minor. No significant commitment of economically or ecologically valuable resources are involved. With the exception of the land area, all the materials for construction and operation of the surface water treatment system will be irrevocably and irretrievably committed to the implementation of remedial action. Most of the facilities proposed for treatment of the Woman Creek Basin seep water utilize pre-existing process equipment and do not require additional purchase and installation of treatment facilities for the IM/IRA.

4.2.3.9 Transportation Impacts

Human health impacts due to transportation include latent effects associated with vehicle pollution, in addition to traumatic injuries and fatalities resulting from accidents. Normal transportation is associated with incremental pollution from engine emissions, fugitive dust generation in the vehicle's wake, and particulates from tire wear. The table below presents estimates of risks (RAO, 1982) resulting from truck and rail transportation. Uncertainties are associated with pollution emission rates and atmospheric dispersion behavior. To compensate for these uncertainties, the analysis utilized conservative estimates for determining pollution health effects. The tabulated accident impacts are average values over population zones (urban, suburban, rural) and are derived from Department of Transportation (DOT) nationwide statistics.

		Health Effects per Kilometer		
Source	Transportation Mode	LCFs*	Injuries	Fatalities
Pollutants	Truck	1.0 E-7 (urban only)		
	Rail	1.3 E-7 (urban only)		
Accidents	Truck		5.1 E-7	3.0 E-8
	Rail		4.6 E-7	3.4 E-8

* LCFs represent latent cancer fatalities resulting from incremental vehicle pollution, and would occur after a latency period following initial exposure.

Excavated soils are to be treated as hazardous material and transported in accordance with appropriate DOT regulations and DOE orders. Transport and handling of other hazardous materials will also be in accordance with appropriate regulations and orders and the On-Site Transportation Manual. Emergency response procedures for accidental spills or container failures are described in Section 17 of the On-Site Transportation Manual. Estimation of transportation impacts for the alternative IM/IRAs is detailed in Appendix I.

4.2.3.10 Wetlands and Floodplains Impact Assessment

The relevant laws and acts which protect wetlands and floodplains include: NEPA of 1969; Section 401 and 402 of the CWA; the Fish and Wildlife Act of 1956 plus associated coordination acts; and regulations promulgated under 10 CFR Part 1022 – DOE Compliance with Floodplain Wetlands Environmental Review Requirements. The rules promulgated under NEPA 42 U.S.C. 4321, et seg., in 40 CFR parts 1500 through 1508 state that all federal agencies are required to consider the environmental affects of any proposed action (EG&G, 1990).

E.O.s that require federal agencies to consider the effects of proposed action on wetlands and floodplains are as follows:

E.O. 11990 Protection of Wetlands (May 24, 1977)

E.O. 11988 Floodplain Management (May 24, 1977)

These orders require federal agencies to avoid, to the extent possible, destruction and modifications of wetlands, and adverse impacts associated with the occupancy and modification of floodplains. Federal agencies are required to determine if wetlands and floodplains are present which may be affected by the action, assess the impacts on these environments, and consider alternatives to the action. DOE regulations establishing policy and procedures for the RFP site in compliance with E.O. 11990 and 11988 are found in Federal Register 44(46): 12594-12599. Wednesday, May 7, 1979.

Documentation of a wetlands and/or floodplain review involves: (1) public notification of intent to perform a wetlands/floodplain review, (2) wetlands/floodplain assessment, and (3) a statement of findings for actions involving floodplains.

When an action in a wetlands and/or floodplain requires an EA, the wetlands and/or floodplain assessment will be prepared concurrent with, and is included in, the EA. Wetlands and/or floodplain assessments that are part of the EA are subject to approval by the Assistant Secretary for the Environment, Safety and Health. Actions in wetlands are likely to require an EA (DOE, 1988).

4.2.3.11 Cumulative Impacts

A "cumulative impact" is defined in 40 CFR 1508.7 as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." Cumulative impacts will incorporate similar, previous IM/IRA actions in the same geographic location and consider impacts on aquatic and terrestrial biota, and impacts from construction and operations of the proposed action to on-site personnel and the general public (DOE, 1988). It is noted that air quality and water quality impacts are not cumulative because emissions, discharges, or releases are not expected to occur during routine operations. Impacts resulting from construction activities or operational accidents would be short lived and are, thus, also not cumulative.

4.2.4 Cost

The criteria for evaluation of remedial alternative cost includes total cost and statutory limits. Total cost includes direct capital costs, indirect capital costs, and operating and maintenance costs. Since the Surface Water IM/IRA at OU 2 is not an EPA-financed remedial action, the $2 million statutory cost limit does not apply.

4.3 ASSESSMENT OF THE NO ACTION ALTERNATIVE

The DOE NEPA Compliance Guide recommends that the No Action Alternative be evaluated in an environmental assessment to establish a baseline against which other "action" alternatives can be evaluated. No Action will consist of only monitoring the Woman Creek Basin seeps and surface waters of the SID and Pond C-2 over the next 7 years until final remediation is implemented. This alternative would not collect, contain, or remove the contaminants identified in the seeps of the Woman Creek Basin.

4.3.1 Environmental Effects of "No Action"

The environmental impacts of the No Action Alternative are evaluated in this section. Sections 4.3.1.1 through 4.3.1.6 discuss air quality, water quality, terrestrial and aquatic impacts, threatened and endangered species, historic and archeological sites, and short- and long-term land productivity. Sections 4.3.1.7 through 4.2.3.11 discuss personnel exposures, commitment of resources, transportation impacts, wetland and floodplain impact assessment, and cumulative impacts. Human health risks from exposure to airborne VOCs that result from no action are included in Section 4.3.1.4. Human health risks from ingestion of untreated water from Pond C-2, conservatively assuming contamination in this pond is due to the Woman Creek Basin seeps, is also included in Section 4.3.1.4.

4.3.1.1 Air Quality

There are no significant impacts to air quality from the No Action Alternative (see Section 4.2.3.1).

4.3.1.2 Water Quality

There are no significant impacts to water quality from the No Action Alternative (see Sections 4.2.3.2 and 2.3.5).

4.3.1.3 Terrestrial and Aquatic Impacts

The premise for the following discussion is that the Woman Creek Basin seeps impact Pond C-2. This is the nearest point of potential aquatic life exposure. However, as discussed in Section 2.3.5, there is no evidence that seep water even reaches the SID or Pond C-2.

Terrestrial Impacts

It is not possible to quantify potential terrestrial impacts from the Woman Creek Basin seeps. However, the following discussion of ecological impacts from plutonium and VOCs indicates that these contaminants within the greater RFP environs are not causing adverse effects.

Radionuclides

Radioecology studies at the RFP compared biological measurements and pathological data between ecologically similar sites with varying plutonium levels (Whicker, 1979). Plutonium concentrations in the soil varied from 2 to 400 microCuries per square meter ($\mu Ci/m^2$). Comparative data were obtained from control areas with plutonium levels on the order of 0.0002 $\mu Ci/m^2$. Biological measurements included: vegetation community structure and biomass; litter mass; arthropod community structure and biomass; population and density of small mammals, biomass, reproduction success; and size of carcass and organs. Pathological examination of small mammals included: x-ray for skeletal sarcomas, microscopy for lung tumors, and necropsy for general pathology and parasite occurrence. Only minor differences in biological attributes between study areas were observed and none was related to plutonium. Pathological conditions and parasites found in rodents occurred with similar frequency in the contaminated areas and the control areas. Cancers and other radiogenic diseases were not found. These observations were continued over a period of 5 years and led researchers to the conclusion that plutonium concentrations at the RFP have not produced demonstrable ecological changes.

"Based on all the plutonium work conducted in the terrestrial environs of Rocky Flats, there is strong evidence that the element is not likely to pose an ecological hazard unless extremely high levels (>>1 milli Curie per square meter [mCi/m^2]) occur. The major reason for this is the extremely low biological mobility of the common chemical forms of the element amply demonstrated in this and other research. Although, uncertainty exists as to possible long-term changes in biological availability of plutonium, we expect gradual soil penetration and dispersion to diminish the present hazard potential with time." (Whicker, 1979).

Little et al. (1980) conducted a comprehensive study in the grassland ecosystem around Rocky Flats. Data indicate radiation doses in vertebrate populations are well below levels known to elicit adverse effects. Studies on soil-plant-animal radionuclide contaminant transfer indicate bioaccumulation does not occur. The Hakonson (1975) study of plutonium levels in soils, plants, and animals resulted in residual plutonium levels approximately 10 times lower in small rodents than in corresponding grass samples.

Volatile Organic Contaminants

VOCs in aqueous media are generally not of immediate concern with respect to adverse effects on terrestrial biota due to their tendency to volatilize. Terrestrial species such as ungulates and coyotes have a wide distribution for habitat utilization, therefore, water consumption will not be soley from the Woman Creek seeps. Small mammals also will not be affected by VOCs in the Woman Creek seeps as their primary source of water is derived from vegetation and invertebrates. Therefore, it is assumed Pond C-2 is a more likely source of water for terrestrial species for risk calculations. As a result, risks to terrestrial biota from VOCs in Pond C-2 is not expected to be much different then the calculated human health risks (see Table 4-5). These risks were estimated from EPA reference doses for VOCs with uncertainty factors ranging from 100 to 1,000 (EPA, 1991). These uncertainty factors can be interpreted as equivalent to safety factors. Safety factors from 100 to 1,000 should be more than adequate to compensate for interspecies variation.

Aquatic Impacts

Radionuclides

The concentration of plutonium in Pond C-2 is low, and even somewhat higher concentrations would not be expected to adversely affect aquatic life. The concentration of plutonium in Pond C-2 of 0.02 pCi/ℓ is below the Colorado state-wide standard (15 pCi/ℓ). With respect to trophic effects, plutonium and americium have not shown an affinity for muscle in higher trophic level organisms (Poston and Klopfer, 1988). In a study conducted at the Savannah River Plant by Whicker et al. (1990), aquatic macrophytes were found to have the highest concentration ratio of radionuclides, where all other trophic levels were found to have very low concentration ratios. Work by Whicker et al. (1990) also confirmed the concept that several long-lived radionuclides tend to reside entirely in sediments. In a study conducted at the Hanford Reservation by Emery et al. (1975), only 5 - 10 percent of the plutonium and americium in sediments in a process waste pond were found to be available for foodweb transfer. The remaining 90 - 95 percent appeared to be tightly bound to particulates.

Volatile Organic Compounds

Many of the VOCs found at OU 2 are known to cause acute and chronic effects on aquatic life depending on the concentration (e.g., carbon tetrachloride, trichlorethene, and tetrachloroethene). However, concentrations of organic compounds in Pond C-2 are well below federal water quality criteria (acute and chronic) for the protection of aquatic life (Table 4-3). In general, VOCs are of greater concern from a public health perspective than they are in terms of effects on aquatic life.

4.3.1.4 Personnel Exposures

The No Action Alternative will have minimal impact on current workers involved in the Woman Creek Basin or adjacent RFP sites. Workers will continue to monitor surface water stations which will not present any additional impacts. Workers will also continue to follow appropriate DOE safety orders providing for occupational health and safety (DOE, 1988).

Potential public health risks resulting from no action have been conservatively assessed assuming all VOCs emerging from the seeps are volatilized, transported, and dispersed to the property line at Indiana Street, and inhaled by a member of the public over the course of 10 years. Computations are shown in Appendix F and risks are provided in Table 4-4.

The calculated cumulative carcinogenic risk provides an estimate of the incidence of cancer from inhalation of these VOCs to the public exposed at the RFP boundary (Table 4-4). This cumulative carcinogenic risk is less than 10^{-9}, well below the value of 10^{-4} used by EPA to establish the need for remediation (OSWER Directive 9355.0-30). It is noted that the actual risk to the public under this scenario approaches zero because a member of the public will not be continuously exposed over the next 10 years to this contamination. Risks to on-site personnel are also of a similar order of magnitude (see Appendix F).

The basic difference in methodology for assessing non-carcinogenic and carcinogenic risk is the assumption that non-carcinogenic health effects are threshold events, whereas carcinogenic risk is a cumulative effect. For non-carcinogens, threshold level intake must be exceeded before potential adverse health effects occur. Non-carcinogenic risks are estimated by the ratio of chronic daily intake of a contaminant (CDI) to a Chronic Inhalation Reference Concentration (CIRC). This ratio is known as a Hazard Quotient (HQ). The sum of the HQ for each contaminant represents the Hazard Index (HI). An HI less than 1 implies that non-

TABLE 4-3

COMPARISON OF AVERAGE CONTAMINANT CONCENTRATIONS IN POND C-2 TO WATER QUALITY CRITERIA

Parameter	Average Concentration in Pond C-2 ($\mu g/\ell$)	Federal Standards: CWA AWQC for Protection of Aquatic Life[a]	
		Acute	Chronic
2-Butanone	5.1	--	--
Tetrachloroethene	2.6	5,280	840
Toluene	2.4	17,500	--
1,1,1 Trichloroethane	2.5	18,000	--
Trichloroethene	2.7	45,000	21,000
Total Xylenes	2.6	--	--

(a) EPA, Quality Criteria for Protection of Aquatic Life, 1986.

AWQC = Ambient Water Quality Criteria

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TABLE 4-4

WOMAN CREEK BASIN IM/IRA
RISKS TO PUBLIC FROM INHALATION AT FENCELINE OF [1]
VOCs FROM WOMAN CREEK BASIN SEEPS

ANALYTE	FLOW-WEIGHTED AVERAGE CONCENTRATION IN WOMAN CREEK SEEPS (ug/l)	CALCULATED AIR CONCENTRATION (mg/cu m)	CHRONIC INHALATION REFERENCE CONCENTRATION (mg/kg/d)	HAZARD QUOTIENT	CARCINOGENIC SLOPE FACTOR 1/(mg/kg/d)	CANCER RISK
1,1 - Dichloroethene*	16.7	3.7E-09	9.0E-03	1.1E-07	1.2	1.7E-10
1,2 - Dichloroethene *	21.5	3.8E-09	1.0E-02	1.0E-07	N/A	N/A
2 - Butanone	6.2	1.4E-09	9.0E-02	4.3E-09	N/A	N/A
Benzene	3.4	7.7E-10	N/A	N/A	2.9E-02	8.7E-13
Carbon Disulfide	3.6	7.9E-10	1.0E-02	2.2E-08	N/A	N/A
Carbon Tetrachloride *	45.1	1.0E-08	7.0E-04	3.9E-06	1.3E-01	5.1E-11
Chloroform *	7.5	1.7E-09	1.0E-02	4.7E-08	8.1E-02	5.4E-12
Tetrachloroethene *	8.9	2.0E-09	1.0E-02	5.5E-08	1.8E-03	1.4E-13
Toluene	2.9	6.4E-10	5.7E-01	3.1E-10	N/A	N/A
Total Xylenes	3.4	7.6E-10	9.0E-02	2.3E-09	N/A	N/A
Trichloroethene	102.3	2.3E-08	N/A	N/A	1.7E-02	1.5E-11
CUMULATIVE RISK				4.3E-06		2.5E-10

1 See Appendix F for risk calculation methods.

* Oral RfD used (see Appendix H)

carcinogenic health effects are not expected. The computed HI (Table 4-4) is less than 10^{-6}, which is well below 1 used by the EPA to establish the need for remediation (OSWER Directive 9355.0-30).

Institutional controls do not permit direct public exposure to the seeps. However, the public could potentially be exposed to Pond C-2 water after it is released and flows offsite. Assuming the unlikely and extremely conservative scenario that all contamination in Pond C-2 arises from the Woman Creek Basin seeps, cumulative carcinogenic risks and non-carcinogenic risks (i.e., the hazard quotient) were calculated for ingestion of untreated Pond C-2 water (Table 4-5). The carcinogenic risk is less than 3×10^{-6}, while the non-carcinogenic risk (HI) is less than 0.02. These risk estimates are well below those used by EPA to establish the need for remediation (OSWER Directive 9355.030). Again, the actual risk to the public under this scenario approaches zero because a member of the public will not be consuming Pond C-2 water continuously over the next 10 years.

4.3.1.5 Commitment of Resources

The No Action Alternative would require monitoring of the Woman Creek Basin seeps and surface waters of the SID and Pond C-2 to be continued over the next 7 years, or until final remediation is implemented. Since monitoring is part of the existing RFP environmental monitoring program, there will be no additional impacts on plant operations and the surrounding community.

4.3.1.6 Transportation Impacts

The No Action Alternative would not involve any impacts to the work force and would eliminate the need for any additional on-site or off-site transportation activities.

4.3.1.7 Wetland and Floodplain Impact Assessment

The No Action Alternative would not impact wetlands or floodplains.

4.3.1.8 Cumulative Impacts

The No Action Alternative will not cause additional on-site or off-site exposures to RFP workers or the public.

TABLE 4-5

WOMAN CREEK BASIN SURFACE WATER IM/IRA NON-CARCINOGENIC AND CARCINOGENIC RISKS FROM INGESTION OF UNTREATED POND C-2 WATER

Analyte	Average Concentration in Pond C-2 Water	Chronic Oral Reference Dose (mg/kg/d)	Hazard Quotient[1]	Carcinogenic Slope Factor	Cancer Risk[2]
Radionuclides					
Plutonium-(total)	0.02 pCi/ℓ	N/A	N/A	3.1E-11 $(pCi)^{-1}$	4.6E-09
Uranium (total)	2.089 pCi/ℓ	N/A	N/A	1.3E-10 $(pCi)^{-1}$	1.9E-06
Americium (total)	0.006 pCi/ℓ	N/A	N/A	3.1E-10 $(pCi)^{-1}$	1.3E-08
Volatile Organic Compounds					
2-Butanone	5.1 μg/ℓ	0.05	2.9E-03	N/A	N/A
Chloroform	2.4 μg/ℓ	0.01	6.8E-03	6.1E-03 $(mg/kg/day)^{-1}$	5.7E-08
Tetrachloroethene	2.6 μg/ℓ	0.01	7.3E-03	5.1E-02 $(mg/kg/day)^{-1}$	5.1E-07
Toluene	2.4 μg/ℓ	0.2	3.4E-04	N/A	N/A
Total Xylenes	2.6 μg/ℓ	2.0	3.7E-05	N/A	N/A
Trichloroethene	2.7 μg/ℓ	N/A	N/A	1.1E-02 $(mg/kg/day)^{-1}$	1.2E-07
TOTAL			**1.7E-02**		**2.6E-06**

[1] Hazard Quotient = $\dfrac{\text{Analyte Concentration } (\mu g/\ell) \cdot 0.001\ mg/\mu g \cdot 2\ \ell/d}{70\ kg * \text{Chronic Oral Reference Dose } (mg/kd/d)}$

[2] For radionuclides the Lifetime Cancer Risk is calculated as follows:

Carcinogenic Risk = Analyte Concentration (pCi/ℓ) * 2 ℓ/d * Slope Factor (pCi^{-1}) *350 d/yr • 10 yr

For VOCs the Lifetime Cancer Risk is calculated as follows:

Carcinogenic Risk = $\dfrac{\text{Analyte Concentration } (\mu g/\ell) \cdot 0.001\ mg/\mu g \cdot 2\ \ell/d * \text{Slope Factor } (mg/kg/day)^{-1} *350\ d/yr * 10\ yr}{70\ kg * 365\ d/yr * 70\ yr}$

[3] Hazard Index = Sum of Hazard Quotients

4.4 IM/IRA ALTERNATIVE NO. 1
BUILDING 231B GAC ADSORPTION SYSTEM/BUILDING 374 LOW-LEVEL WASTEWATER TREATMENT SYSTEM

4.4.1 Description

4.4.1.1 Surface Water Collection

Figure 4-3 shows the locations of the surface water diversion and collection systems proposed for the Woman Creek Basin IM/IRA. The collection systems (CSs) are denoted CS-55 and CS-53. CS-55 and CS-53 will collect flows from the 903 Pad and Lip Area seeps and SW-53, respectively, and allow pumped transfer of collected surface water outside of the 903 Pad and Lip Area as shown in Figure 4-3.

Design flow rates for surface water collection systems CS-55 and CS-53 are based on flows from stations SW-55 plus SW-77 and SW-53, respectively. The design flow rates are estimated maximum flows excluding flows related to high precipitation events. Only design flows at CS-55 and CS-53 will be collected for subsequent treatment under the proposed Woman Creek Basin IM/IRA. Review of the 1987, 1988, 1989, 1990, and 1991 field investigation records reveals that for all IM/IRA surface water monitoring stations either a "DRY," "standing water only," or "immeasurably low flow" was observed for each sampling event. To complement the historical observations and to obtain additional wet season seep flow information, site visits were conducted in April 1990, May 1991, and June 1991. During the April 1990 site visit, a flow of approximately 2.8 gpm was estimated at SW-55 using a bucket and stopwatch. Surface water seep flows at SW-77 and SW-53 were imperceptible at the time of the April 1990 site visit, and quantitative measurements were not obtained. During the 1991 site visits, visual estimates of flow were made at the IM/IRA surface water seeps and monitoring stations. The observations are presented in Table 4-6.

Based on historical records and recent observations of flows at SW-55, SW-77, and SW-53, design flow rates for CS-55 and CS-53 were established (Table 4-6). A design flow rate of 3 gpm was assigned to CS-55 based on the maximum recorded flow rate at SW-55, 2.8 gpm. A 3 gpm design flow at CS-55 should be more than adequate to also account for flow contributions from SW-77. As indicated in Table 4-7, a design flow rate of 1 gpm was assigned to CS-53. This assignment is based on the maximum estimated flow observed at SW-53 (4 June 1991 field investigation).

As mentioned earlier, this IM/IRAP provides for collection of design flows at CS-55 and CS-53. Flows in excess of the established design flows (Table 4-7) may be allowed to overflow the collection systems and continue downgradient along their pre-IM/IRA pathways. A conservative estimation of annual collection of seep water by CS-55 and CS-53 is 700,000 gallons. This estimation is based on surface water flows occurring at

TABLE 4-6

ESTIMATES OF SURFACE WATER FLOW AT SW-55, SW-77, AND SW-53

	ESTIMATED FLOW (gpm)[1]		
Date	SW-55	SW-77	SW-53
31 May 1991	<0.1	0	0
04 June 1991	0	0	1
21 June 1991	0	<0.1	<0.1
28 June 1991	0.5	0	0

1 The flows listed are visual estimates by RFP personnel rather than measurements obtained with flow instrumentation.

TABLE 4-7

DESIGN FLOW RATES FOR SURFACE WATER DIVERSION AND COLLECTION SYSTEMS

Collection System		Design Flow Rate (gpm)
[1]CS-55		3.0
[2]CS-53		1.0
	TOTAL	4.0

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1 The CS-55 design flow rate is based on maximum estimated flows at SW-55 (2.8 gpm) and SW-77 (0.2 gpm) excluding flows related to high precipitation events.

2 The CS-53 design flow rate is based on a maximum estimated flow at SW-53 (1 gpm) excluding flows related to high precipitation events.

SW-55, SW-77, and SW-53 at their respective design flows 120 days per year, 24 hours per day. This estimate of annual seep water collection is used throughout this document for purposes of conceptually designing the surface water collection, transport, and treatment systems. Continuous seepage for 120 days at the design flows is considered a conservatively large volume of water for concept design.

As discussed above, the 903 Pad and Lip Area seeps will be collected by CS-55. CS-55 will include a sump installed at the outlet of the culvert at SW-55. This collection scheme makes use of the existing surface water diversion pathways and flows described in Section 2.3.5. Installation of a lined trench connecting SW-77 to SW-55 will allow collection of the flow from SW-77 in CS-55. The flow from SW-53 will be collected by CS-53. As with CS-55, CS-53 will include a sump at the outlet of the culvert that drains SW-53. The CS-55 and CS-53 sumps will each be equipped with a level sensor and sump pump.

IM/IRA Alternative No. 1 requires that seep water collected by CS-55 and CS-53 be transferred to the Building 231B GAC Adsorption Treatment System (described below). The proposed transfer is by a combination of pipeline and tank truck transport. As illustrated in Figure 4-3, a pipeline will be installed to connect the CS-55 and CS-53 sumps to a transfer station located outside of the 903 Pad and Lip restricted work area at the top of the area north access road. The pipeline will allow for pumped transfer of surface water from each of the sumps to the transfer station. The transfer station will consist of a RCRA pad large enough to accommodate a small tank truck. The transfer station will also include a control box containing sump level indication and sump pump control instrumentation. The transfer station will allow a trained operator to monitor water levels in the CS sumps and pump the water from the sumps into a tank truck. Once loaded into the tank truck, a driver will transport the surface water to the Building 231B GAC Adsorption Treatment System where it will be transferred to one of the process influent storage tanks. The one-way travel distance between the surface water transfer station to the GAC Adsorption System is approximately 1 mile via Central Avenue and 7th Street.

For cost estimating purposes, it will be assumed that the CS-55 and CS-53 sumps will be pre-cast concrete structures each with a capacity of 5,000 gallons. It is also assumed that double-walled PVC piping will be used to construct an above-ground pipeline connecting the sumps to the transfer station. The pipeline will be insulated and heat traced to prevent freezing during the winter months. Leak detection sensors will be strategically placed in the secondary containment cavity pipeline and electrically connected to leak alarms located on the control box. Also for cost estimating purposes, it will be assumed that the transfer station pad will include a sump to contain at least 10 percent of the capacity of a collection system sump (i.e., 500 gallons). The transfer station control box will be designed and fabricated to be weather-tight and securable. Control box design will also provide for insulation and heating to ensure reliable operation during the winter months. Power to operate the sump pumps, heat tracing, and instrumentation will be obtained from existing power lines in the 903 Pad and Lip Area.

4.4.1.2 Surface Water Treatment

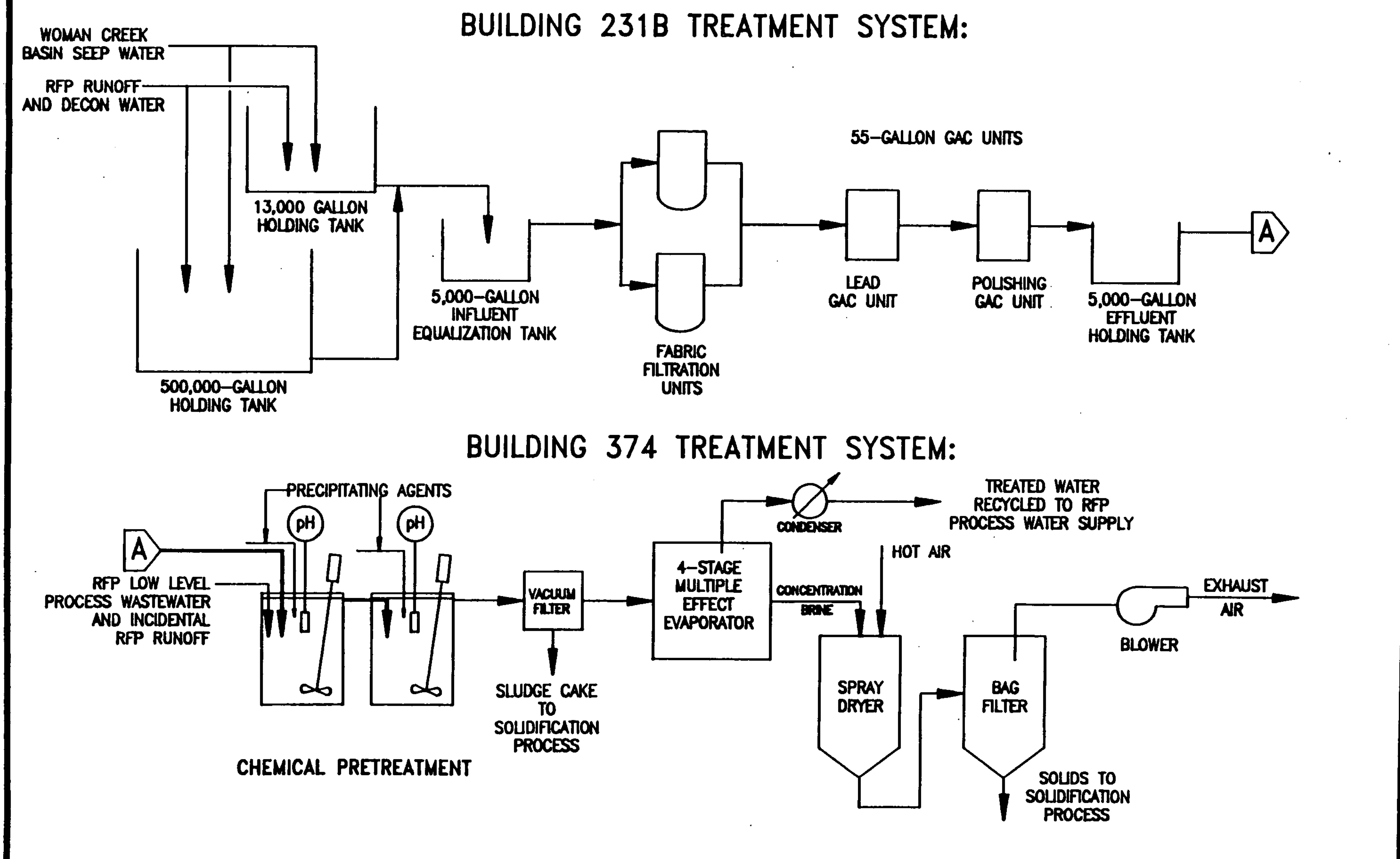
The surface water treatment facilities proposed for IM/IRA Alternative No. 1 include the GAC adsorption system that is planned to be constructed near Building 231B and the existing Building 374 Low-Level Wastewater Treatment System. Use of these facilities allows treatment of collected Woman Creek Basin seep water without installation of additional treatment process equipment for the IM/IRA. The "Building 231B GAC Adsorption System" and Building 374 Low-Level Wastewater Treatment System are illustrated in Figure 4-4 and described below in detail .

The GAC adsorption system illustrated in Figure 4-4 is planned for construction near Building 231B in March 1992. This facility is being installed to provide VOC treatment for decontamination wastewater generated at the RFP (e.g., drill rig decontamination). Current treatment system design includes installation of a 13,000-gallon wastewater holding tank and a 5,000-gallon influent equalization tank. The 500,000-gallon wastewater holding tank shown in Figure 4-4 currently exists, but is not in use. Operating plans for the 231B GAC Adsorption System include use of this storage tank for additional influent storage capacity, when required. Treatment system design includes at least two fabric filtration units configured in parallel. The parallel configuration allows water to be treated with one filter on line while filtration media in the other filter is being replaced. Due to the relatively small quantities of decontamination wastewater generated annually (approximately 500,000 gallons) treatment system design includes disposable GAC units. The process will include two 55-gallon GAC units in a lead/polisher arrangement. Each 55-gallon unit is 36 inches high and 22 inches in diameter, and contains approximately 165 pounds of GAC. The maximum rated flow capacity through each unit is 10 gpm. Although the fabric filtration units will remove the majority of the suspended solids from the process influent, small particulates will pass through to the GAC units. It is, therefore, expected that the GAC units will be contaminated with particulate radionuclides and, thus, require disposal as a hazardous mixed waste. The treatment system includes a 5,000-gallon effluent storage tank to temporarily hold processed water prior to transport to Building 374.

The plan of operation for the Building 231B GAC Adsorption Treatment System includes tank truck transport of decontamination wastewater to the facility, batch processing of approximately 10,000 gallons per week at a flow rate of approximately 7 gpm, and tank truck transport of the treated effluent to the Building 374 Low-Level Wastewater Treatment System. The one-way travel distance between Building 231B and Building 374 is approximately 1 mile via 7th Street, Central Avenue, PA Porthole #1, and west on Patrol Road.

The Building 374 Low-Level Wastewater Treatment System (Figure 4-4) processes approximately 12 to 15 million gallons per year of low level wastewater (i.e., < 13,500 pCi/ℓ of radioactivity). Influent sources for this system include RFP process wastewater and incidental RFP surface waters (i.e. site runoff). The treatment system includes chemical precipitation, vacuum filtration, and evaporation unit operations. Chemical treatment

R37034.MB073191



U.S. DEPARTMENT OF ENERGY Rocky Flats Plant Golden, Colorado	IM/IRA ALTERNATIVE NO. 1 BUILDING 231B GAC SYSTEM (PLANNED)/ BUILDING 374 LOW-LEVEL WASTE TREATMENT SYSTEM	FIGURE 4-4

involves addition of iron salts and lime to cause coagulation and flocculation of suspended particulates present in the wastewater to produce a filterable precipitate or floc. Radionuclide and metals contaminants present in the wastewater stream in a particulate state tend to become enmeshed in the floc as discussed in Section 4.5.1.2. The floc is then removed from the process stream by vacuum filtration. The filter cake produced is approximately 30 percent solids by weight, and is stabilized with the addition of portland cement. The inorganic contaminants in the filtered process stream are then concentrated by a four-stage multiple effect evaporator. Evaporator vapors, which are free of inorganic contaminants, are condensed and recycled to the RFP process water supply. The "brine" concentrate is processed by a spray dryer to evaporate the remaining liquid. The resulting byproduct solids (i.e., salts) are removed from the process by a bag filter unit, solidified with the addition of portland cement. This "saltcrete" is disposed offsite at the Nevada Test Site.

IM/IRA Alternative No. 1 includes use of the Building 231B GAC Adsorption System and the Building 374 Low-Level Wastewater Treatment System as they are currently planned and operated, respectively. The treatment technologies that comprise these facilities (GAC adsorption, chemical precipitation/vacuum filtration, and evaporation) are well suited for removal of VOCs, radionuclides, and metals that may be present in the Woman Creek Basin seep water. In addition, extra processing capacity exists at both facilities to accommodate the estimated maximum volume of 700,000 gallons of seep water collected annually. Although the Building 374 treatment facility often operates at its maximum capacity, influent storage at Building 231B and batch processing of collected seep water allows use of the facility during off-peak periods. Therefore, implementation of IM/IRA Alternative No. 1 does not require modification to Building 231B or Building 374 treatment systems for the Woman Creek Basin IM/IRA for either contaminant removal or process capacity reasons.

4.4.2 <u>Effectiveness</u>

4.4.2.1 Surface Water Collection

Surface water collection by diversion at the sources is an effective method for collecting Woman Creek Basin seep water. Minimization of contaminated surface water contact with the environment is achieved by diverting and collecting surface seep water at or near the sources. Downstream contaminant migration via surface water and ground water (if occurring) and release of VOCs to the atmosphere is minimized with this surface water collection system. The implementation of this collection action should not adversely affect the safety of nearby communities, and the risk to the environment should not be increased.

Since surface water collected in the CS-55 and CS-53 sumps is transferred by pipeline directly to a tank truck, operator exposure to surface water is minimized. Likewise, sediments accumulating in the sumps may be removed by a vacuum line and loaded directly into a tank truck. Where potential worker exposure to contaminated surface water and sediments may occur, pumping equipment minimizes contact time, and standard personal protective equipment (PPE) will offer a high degree of protection.

Residuals (i.e., collected sediments) will not remain on site; they will be treated or disposed of according to the standard RFP waste management procedures and project-specific SOPs. The SOPs will be prepared after the IM/IRA design is finalized to address specific waste handling activities. The collection structures are simple in design, and will require little periodic preventive maintenance to ensure continued reliability over the life of the IM/IRA.

4.4.2.2 Surface Water Treatment

Building 231B GAC Adsorption System

GAC adsorption has been shown to remove VOCs from contaminated water to levels that comply with the ARARs. The EPA (*Federal Register*, Vol. 52, No. 130, page 25698) has designated GAC adsorption a "Best Demonstrated Available Technology" (BDAT) for the removal of seven specific VOCs from drinking water which includes common chlorinated solvents. This assumes that vinyl chloride, methylene chloride, and acetone are not present in the Woman Creek Basin surface water influent since these compounds are not readily adsorbed from solution using GAC. The surface water quality data presented in Appendix B indicates that for all sampling events at all Woman Creek Basin IM/IRA surface water monitoring stations, vinyl chloride was present above detection limit only once at SW-77. In addition, methylene chloride and acetone have always been estimated below detection limits and/or were also present in the associated laboratory blanks.

The operators of the Building 231B GAC Adsorption System will not be exposed to VOC-laden GAC since direct handling of the GAC is not required. The GAC is containerized in 55-gallon drums, and the units are sealed and designed to be disposed when spent rather than be regenerated. The operators need only follow routine safety procedures that are appropriate to handling heavy equipment. Spent fabric filter media and GAC will most likely require disposal as a hazardous mixed waste due to contact with radionuclide-bearing particulates. Pre-treatment to remove radionuclides is not considered in this alternative treatment system which relies entirely on existing facilities. Thus, disposal of spend carbon as a mixed waste, as opposed to regeneration of the carbon which would be an alternative to land disposal, is considered a limitation of this alternative.

GAC adsorption treatment in containerized, disposable units does not produce any vapor emissions. The safety of nearby communities should not be adversely affected and the risk of harm to the environment should not be increased. This treatment process will effectively remove all of the target organic contaminants from the surface water. Treated water will be monitored at the effluent and also at an intermediate point in the system to ensure that all contaminants are below ARARs before being transported to Building 374 for inorganics treatment.

Building 374 Low-Level Wastewater Treatment System

Chemical precipitation and vacuum filtration is a common suspended solids pretreatment technology. Effluent suspended solids concentrations are typically less than 1 mg/ℓ. Because radionuclides and metals present in surface water are largely associated with the suspended solid fraction, chemical precipitation and vacuum filtration is anticipated to remove the majority of these contaminants. The Building 374 treatment system provides reliable and semi-automatic surface water treatment service requiring minimal operator intervention. Filter cake generated by the process must be collected for solidification. Filter cake handling equipment minimizes worker contact time, and standard PPE with splash protection offers a high degree of protection. Solidification of filter cake by cementation is an effective method of reducing the mobility of inorganic contaminants present in the waste stream.

Evaporation of the filtrate is very effective at concentrating inorganic contaminants in the aqueous phase while producing a contaminant-free vapor stream. This is based on the non-volatile character of the inorganic constituents at the process operating temperatures (i.e., boiling point of water). Although a concentrated wastewater stream is generated by the evaporator, subsequent processing of the concentrate by a spray dryer removes the balance of the water from the stream, thus minimizing the volume of waste salts. Potentially contaminated particulates present in the spray dryer off-gas are removed from the process stream by fabric filtration. Fabric filter emissions are monitored to ensure that dust emissions are within regulatory compliance. The evaporation unit, spray dryer, and fabric filtration unit provide reliable and automatic service requiring minimal operator intervention. Waste salts produced by the spray dryer and fabric filter must be collected for solidification. Waste salt handling equipment minimizes worker contact with the waste, and standard PPE offers a high degree of protection to the worker. Solidified filter cake and waste salt residuals will be managed according to standard RFP waste management procedures and Building 374 operation-specific Standard Operating Procedures (SOPs).

4.4.3 Implementability

4.4.3.1 Surface Water Collection

The equipment and materials required to construct the surface water diversion, collection, and transfer systems are standard and readily available. The systems are standard in design and do not require special skills for installation. Sump and pipeline installation may result in disturbance of potentially contaminated soils and potential impact to the environment by release of contaminated dust to the atmosphere and release of contaminated soil via surface water runoff. This impact will be minimized by implementing project-specific health and safety plan procedures during construction (e.g., dust suppression, windspeed monitoring/construction shutdown). The proposed collection system locations are easily accessible and power exists in the area. Since the collection systems are simple in design, they should offer reliable and relatively maintenance-free operation over the life of the IM/IRA. Sumps will require periodic cleaning to remove accumulated solids. Tank truck transport of collected water to Building 231B is via paved roads within the RFP site. The proposed transportation route offers a safe and reliable means of water conveyance.

4.4.3.2 Surface Water Treatment

IM/IRA Alternative No. 1 makes use of planned and existing RFP treatment facilities. No new surface water treatment units are required to accommodate processing of Woman Creek Basin seep water. The Building 231B GAC Adsorption System possesses a substantial amount of influent storage capacity to allow coordination with the operation of both the GAC Adsorption System and the Building 374 Low-Level Wastewater Treatment System. The resources required to effectively operate the treatment systems include GAC units, water treatment chemicals (i.e., ferric sulfate, lime, and sulfuric acid), and Portland cement. These materials are readily available. Off-site permitted disposal facilities are available for disposal of spent GAC and solidified filter cake.

A high degree of public acceptance is anticipated for IM/IRA Alternative No. 1 based on GAC Adsorption's BDAT classification as well as the demonstrated performance of the Building 374 Low-Level Wastewater Treatment System. The public should also strongly support the recycle of treated Woman Creek Basin surface water to RFP operations.

4.4.4 <u>Environmental Impact</u>

4.4.4.1 Surface Water Collection

<u>Personnel Exposure</u>

Personnel exposures resulting from the proposed surface water collection system for IM/IRA Alternative No. 1 are predicted based on the analysis methodologies and details presented in Appendix H. Maximum worker exposures from construction of the collection system would result in a cancer risk of 1×10^{-7}, a noncancer HI of 4×10^{-4}, and a radiological dose of 3 mrem (CEDE). The highest exposures potentially received by other onsite personnel would correspond to a cancer risk of 2×10^{-9}, a HI of 8×10^{-6}, and a radiological dose of 5×10^{-2} mrem (CEDE). Offsite impacts to a member of the public would be negligible, considering the additional dispersion distance to the plant boundary, and would be well below annual dose limits for the public from airborne emissions as discussions in Section 4.2.3.7. Exposures to potential receptor categories (workers, other site personnel, and the public) during routine operations are predicted to range from very low to negligible, as discussed in Appendix H.

Commitment of Resources

The commitment of resources (materials) for construction and installation of the surface water collection systems are included in Section 4.4.5. The capital costs for equipment, materials, and installation of the collection systems are approximately $205,000.

Transportation Impacts

The proposed surface water collection system involves transportation activities during construction and routine operations. Construction transportation activities will primarily involve the movement of equipment for excavation/grading, sump and pipeline installation, material deliveries for construction, and potential offsite disposal of excavated soils resulting from sump installation. Routine operations will require the transfer of collected water to Building 231B, periodic inspection and maintenance of the sumps and pipeline, and occasional offsite shipment of sump sediment to a low-level mixed waste disposal site. Potential health effects from fugitive dust during construction will have negligible impacts, as discussed earlier in this section. Given the limited extent of transportation activities associated with the collection system and the health effect estimates presented in Appendix I, transportation health effects are predicted to be very small. Additional discussion details are provided in Appendix I.

Floodplain Assessment

No part of the water collection system or activity under any of the alternatives will be located in, or affect, a floodplain.

Wetland Assessment

Wetlands areas have been identified below CS-53 and CS-55 (see Figure 4-3 for the location of those two water collection sites). The wetland area below CS-53 less than 500 square feet and is fed by a flow typically less than one gallon-per-minute for less than 120 days per year from a seep identified as SW-53. That flow typically evaporates and/or reinfiltrates within 50 to 60 feet of CS-53.

The wetland area below CS-55 is approximately 500 square feet and is fed by a flow typically not exceeding three gallons-per-minute for less than 120 days per year from seeps identified as SW-50, SW-51, SW-52, SW-57, SW-58, and SW-77. As with the water at CS-53, this water also typically evaporates and/or reinfiltrates within 50 to 60 feet of the collection point.

Collection of water at CS-53 and CS-55 will have no impacts on any wetlands between the seeps and the collection points, but will dry up the small areas of wetlands below the two collection points. This is anticipated to result in the demise of the wetland vegetation which will be replaced with the same type of upland vegetation that predominates naturally in the surrounding area. When water collection ceases and water again flows past CS-53 and CS-55, it is expected that wetland vegetation will again establish itself naturally.

Inasmuch as there are no technologies for treating water *in situ* in a situation such as the one, removal, or collection, of the water is a necessity. Alternative water collection methodologies are discussed in Section 4.1.1. The only alternative to the preferred collection method (i.e., collection of surface water) is installation of a well array or French Drain system which would lower the water table sufficiently that all the seeps would become dry and cease to flow. This alternative would dry up the wetlands between the seeps and the collection points, in addition to those below the collection points, resulting in a greater wetland impacts than surface water collection.

If a treatment alternative is selected, its purpose would be to remove contaminants from the water that might reach a drinking water source. While it would be possible to reintroduce the treated water at the collection point, thus preserving the wetland areas, such a program would simply reintroduce clean water into a local ground water system that is contaminated. This would contribute to an increased potentiometric surface and this an increased potential for contaminant migration.

Cumulative Impacts

Construction activities will result in increased vehicular traffic, engine emissions, and the number of workers. The number of personnel required for the project will be a small increase to the assumed yearly additional construction loading.

It is estimated that four workers will be involved in routine operation and maintenance of the surface water collection system. This will have negligible impact on the number of Plant personnel. In routine operations, these workers will not be exposed to any levels of chemicals or waste stream pollutants that would restrict them from other assignments at the RFP.

4.4.4.2 Surface Water Treatment

Personnel Exposures

As discussed in Appendix H, potential exposures of onsite and offsite personnel to hazardous and radiological contaminants during routine operations would range from very low to negligible because of very small release potentials, process design features, personnel protective measures, and exposure distances. Releases from any accidents would create the potential for short-duration airborne VOCs and would be limited by implementing appropriate OSA procedures.

Commitment of Resources

The surface water treatment facilities proposed for IM/IRA Alternative No. 1 include the future GAC adsorption system that is planned to be constructed near Building 231B and the existing Building 374 Low-Level Wastewater Treatment System. Use of these facilities allows treatment of collected Woman Creek Basin surface seep water without a commitment of additional resources (materials and equipment).

Treatment of contaminated surface water from OU 2 will result in an incremental increase in site deliveries of GAC and replacement units. Deliveries will be spread out over the course of the year and will be handled by one of the existing Plant chemical suppliers.

Transportation Impacts

The surface water treatment process for IM/IRA Alternative No. 1 utilizes existing or planned facilities, with the exception of the installation of a 5,000-gallon tank. Consequently, there are no significant incremental construction related transportation impacts for this treatment alternative. Transportation activities during routine operations will include the delivery of process chemicals, tank truck transfer of partially treated water from to be very small (see Appendix I). Building 231B to Building 374, and offsite shipment of process sludge and expended GAC to a low-level mixed waste disposal site. As with the collection system transportation impacts, given the limited extent of transportation activities and the nature and quantities of materials shipped, potential health effects are projected

Wetland and Floodplain Impact Assessment

The surface water treatment system proposed for Woman Creek Basin IM/IRA Alternative No. 1 will not require construction of treatment facilities, and, therefore, will not impact any wetlands or floodplains.

Cumulative Impacts

Routine processing of the surface water collected from the surface seeps and drainages will result in some additional solid wastes being generated from the site. Generation of sludge cake by the Building 374 Treatment System is estimated to be a maximum of 70 cubic yards annually. The sludge cake will be treated on site and managed according to standard RFP waste management procedures and Building 374 operation-specific SOP.

Drying of the semi-solid sludge waste from the treatment system will require an increase in Plant solidification operations to dry and package the waste for transport to a final disposal site. Neither the drying nor packaging requirement will significantly effect routine operations because of the otherwise high workload of the facility. Radionuclide accumulation in the sludge is not expected to exceed exempt quantities by weight, so that shipment of the sludge is not expected to cause any special concern or require unusual controls.

It is estimated that four workers will be involved in routine operation and maintenance of the treatment facility. This will have negligible impact on the workload of Plant personnel. In routine operations, these workers will not be exposed to any levels of chemicals or waste stream pollutants that would restrict them from other assignments at the RFP. Cumulative impacts of IAG interim remedial actions assuming implementation of Woman Creek Basin IM/IRA Alternative No. 1 is included in Table 4-8.

4.4.5 Cost

Assumed costs for implementation and operation of IM/IRA Alternative No. 1 are presented in Table 4-9. All capital costs (i.e., equipment, materials, and installation) required for implementation of this alternative are for the surface water collection system. No capital costs are required for surface water treatment. Annual operation and maintenance cost items listed in Table 4-9 for surface water treatment are incremental costs associated with processing the additional influent load from Woman Creek Basin. The incremental cost items include GAC consumption, spent GAC disposal, coagulation and flocculation agents, filter cake disposal, and evaporator fuel costs. The basis of computation of all surface water collection and treatment costs listed in Table 4-9 are presented in the footnotes at the end of the table.

The total capital cost to implement IM/IRA Alternative No. 1 is $288,400. Annual operation and maintenance costs are approximately $102,600. Based on a 30-year operating life, 10% interest rate, and a zero salvage value, the present worth of IM/IRA Alternative No. 1 is $1,255,600.

TABLE 4-8

CUMULATIVE IMPACTS OF IAG INTERIM REMEDIAL ACTIONS ASSUMING IMPLEMENTATION OF WOMAN CREEK BASIN IM/IRA ALTERNATIVE NO. 1

Impact Category	OU 1 Ground-Water IM/IRA 881 Hillside Ground-Water Treatment System	South Walnut Creek Basin Surface Water IM/IRA Chemical Precipitation/ Microfiltration and GAC Adsorption System	Alternative No. 1 Building 231B GAC Adsorption System/ Building 374 Low-Level Wastewater Treatment System	Cumulative Impacts
Environmental Impacts				
Aquatic Impacts	None	None	None	Negligible
Threatened and Endangered Species	None	None	None	None
Historic and Archeological Sites	None	None	None	None
Short- and Long-Term Land Productivity	None	None	None	None
Wetland and Floodplain	None	Minimal	Minimal	Minimal
Excavation	10,300 yd^3	None	<100 yd^3	10,400 yd^3
Well Drilling	None	None	None	None
Long-Term Considerations				
Interim Removal Action	Approximately 30 years	Approximately 30 years	30 years[1]	N/A
VOC Contamination Removal	Yes	Yes	Yes	N/A
VOC Contaminant Destruction	Yes	Yes[4]	No	N/A
Inorganic Contaminant Removal	Yes	Yes	Yes	N/A
Exposure to General Public				
Construction	Yes	No	Yes[2]	Yes
Routine	No	No	No	No
Accident	No	No	No	No
Exposure to Workers				
Construction	Negligible	Yes	Yes[2]	Yes
Routine	Negligible	Minimal	Minimal	Minimal
Accident	Yes	Yes	Yes	Yes

TABLE 4-8 (Continued)

CUMULATIVE IMPACTS OF IAG INTERIM REMEDIAL ACTIONS ASSUMING IMPLEMENTATION OF WOMAN CREEK BASIN IM/IRA ALTERNATIVE NO. 1

Impact Category	OU 1 Ground-Water IM/IRA 881 Hillside Ground-Water Treatment System	South Walnut Creek Basin Surface Water IM/IRA Chemical Precipitation/ Microfiltration and GAC Adsorption System	Alternative No. 1 Building 231B GAC Adsorption System/ Building 374 Low-Level Wastewater Treatment System	Cumulative Impacts
Off-Site Transportation				
Construction (truckloads)	<10	<5	<5	<20
Operation (loads/year)	<5	<5	1	<10
Contaminated Materials (truckloads)	Not Determined	Not Determined	1[3]	Not Determined
On-Site Transportation				
Construction (truckloads)	<20	<10	<5	<40
Operation (loads\year)	<10	<10	300	320

1 Assuming 7 years as IM/IRA

2 Collection system only

3 Solidified filter cake & disposable GAC unit

TABLE 4-9

ASSUMED COSTS FOR IM/IRA ALTERNATIVE NO. 1
BUILDING 231B GAC ADSORPTION SYSTEM/BUILDING 374
LOW-LEVEL WASTEWATER TREATMENT SYSTEM

A. EQUIPMENT AND MATERIALS		CAPITAL COST (DOLLARS)	ANNUAL COST (DOLLARS)
Surface Water Collection:			
Quantity	Item		
2	5,000-gallon precast concrete sump	20,000	
2	Sump pump	1,000	
2	Sump level instrumentation	2,400	
2,400 l.f.	Double-walled, insulated, heat traced PVC piping (design and fabricate)	8,400	
6	Pipeline leak detection sensors	1,800	
2,400 l.f.	Above-ground pipe support structure (design and fabricate)	13,200	
1	Pipeline diverter valve with actuator	3,500	
100 cu. yd.	Concrete for transfer station pad	12,500	
1	[1]Transfer Station control box (design and fabricate)	9,200	
1 lot	Electrical wiring, conduit, mounting brackets	3,000	
1	5,000-gallon tank truck	70,000	
Surface Water Treatment: None required.			
B. INSTALLATION			
Surface Water Collection:			
Quantity	Item		
2	[2]Sump installation	6,200	
1	[3]Trench construction	1,800	
2,400 l.f.	[4]Pipeline and pipeline support structure installation	10,800	
1 lot	[5]Control box installation, instrumentation and power wiring	4,800	
1 lot	[6]Contaminated soil disposal	37,400	
Surface Water Treatment: None required			

TABLE 4-9 (Continued)

ASSUMED COSTS FOR IM/IRA ALTERNATIVE NO. 1
BUILDING 231B GAC ADSORPTION SYSTEM/BUILDING 374
LOW-LEVEL WASTEWATER TREATMENT SYSTEM

			CAPITAL COST (DOLLARS)	ANNUAL COST (DOLLARS)
C.	OPERATION AND MAINTENANCE			
	Surface Water Collection:			
	Quantity	Item		
	2	[7]Collection system cleaning		3,800
	--	[8]Sediment disposal		1,000
	--	[9]Pipeline maintenance		4,300
	--	[10]Power		4,400
	--	[11]Tank truck operation		30,400
	Surface Water Treatment:			
	Quantity	Item		
	5	[12]55-gallon disposable GAC unit		4,000
	5	[13]Spent GAC unit disposal cost		5,000
	--	[14]Treatment chemicals		1,500
	--	[15]Sludge waste disposal		2,300
	--	[16]Evaporator fuel costs		2,200
	--	[17]Monitoring and Analysis		---
	--	[18]Tank Truck Operation		26,600
		SUBTOTAL	$206,000	$ 85,500
D.	ENGINEERING AND CONTINGENCY			
	Design at 15% of Total Capital Cost		$30,900	
	Construction Management at 5% of Total Capital Cost		10,300	
	Contingency at 20%		41,100	17,100
		TOTAL COST	$288,400	$102,600

E. PRESENT WORTH ANALYSIS

Present Worth Factor (PWF)	=	9.427 (30 years, 10% i for annual costs)
$102,600/year @ 9.427	=	$967,200
1992 Capital Cost	=	$288,400
		$1,255,600

TABLE 4-9 (Continued)

ASSUMED COSTS FOR IM/IRA ALTERNATIVE NO. 1
BUILDING 231B GAC ADSORPTION SYSTEM/BUILDING 374
LOW-LEVEL WASTEWATER TREATMENT SYSTEM

[1] Transfer station control box includes sump level and pipeline leak detection instrumentation and pump control equipment. Control box is weather-tight, insulated, and heated.

[2] Sump installation costs are based on 70 manhours of labor at $60/hr, plus a $2,000 backhoe rental charge.

[3] Trench construction (i.e., SW-77 to SW-55) costs are based on 30 manhours of labor at $60/hr.

[4] Pipeline and pipeline support structure installation costs are based on 180 manhours of labor at $60/hr.

[5] Control box installation and instrumentation and power wiring costs are based on 80 manhours of labor at $60/hr.

[6] To be conservative in costing, it is assumed that soils excavated for CS sump and trench installation will be disposed as hazardous mixed waste ($450 per cubic yard transportation and disposal cost at the Nevada Test Site). The estimated volume of excavated soils is approximately 43 cubic yards for CS-55 (sump and trench) and 40 cubic yards for CS-53 (sump).

[7] Annual CS cleaning (i.e., sediment removal from sumps and trench) costs are based on 64 manhours of labor at $60/hr.

[8] To be conservative in costing, it is assumed that recovered CS sediments will be disposed as hazardous mixed waste ($450 per cubic yard transportation and disposal cost at the Nevada Test Site). The estimated cost is based on approximately 2 cubic yards of sediment waste generated annually.

[9] Annual pipeline maintenance costs are based on 72 manhours of labor annually at $60/hr.

[10] Annual electric power costs are based on two 2-hp sump pumps operated continuously for 120 days/year plus a heat trace load of approximately 25 kw (pipeline, and control box) operated continuously for 90 days/year. (Conversion factors: 0.7457 kw/hp, $0.07/kwh).

[11] Tank truck operation costs for CS-55 and CS-53 are based on continuous transfer of CS design flow rates for 120 days/year. This conservative assumption for CS operation requires CS-55 and CS-53 to be emptied daily and once every 3 days, respectively. This mode of operation requires that 160 trips/year be made between the transfer station and the treatment system. Assuming 3 hours/transfer, $10 per trip for fuel and maintenance, and a $60/hr labor charge, annual tank truck operation is computed to cost $30,400.

[12] GAC consumption costs are based on 700,000 gallons of surface seep water processed annually (CS-55 and CS-53 operating continuously at their design flows for 120 days/year) at a GAC consumption rate of 1 lb/1,000 gallons of water processed. The cost of one 55-gallon disposable GAC unit containing 165 lbs of GAC is approximately $800.

[13] To be conservative in costing, it is assumed that spent GAC units will be disposed as a hazardous mixed waste ($1,000 per drum transportation and disposal cost at the Nevada Test Site).

[14] Chemical consumption costs are based on 700,000 gallons of surface seep water processed annually, requiring 0.3 pounds of iron and 1 pound of lime per 1,000 gallons of water treated.

[15] To be conservative in costing, it is assumed that vacuum filter cake will be disposed as a hazardous mixed waste ($450 per cubic yard transportation and disposal cost at the Nevada Test Site). Annual production of filter cake is based on 700,000 gallons of surface seep water processed containing approximately 350 ppm of suspended solids plus the chemical additions noted in footnote 14. The filter cake produced is assumed to be 30% solids by weight with a density of 80 lbs/cubic foot (conversion factors: 7.45 gallons/cubic foot, 8.34 pounds of water/gallon).

[16] Evaporation fuel costs are based on processing 700,000 gallons of surface seep water annually at a cost of $0.40 per 1,000 standard cubic feet of natural gas. (Conversion factors: 7.48 gallons/cubic foot, 8.34 lbs/gallon of water, 970 BTU required to evaporate 1 pound of water).

[17] Monitoring and laboratory analytical costs are not included because they are the same for all treatment alternatives considered for the surface water IM/IRA.

[18] Tank truck operation costs are based on 140 water transfer trips between Building 231B and Building 374, each requiring 3 hours. A $60/hr labor rate plus $10/trip for fuel and maintenance is assumed.

4.5 IM/IRA ALTERNATIVE NO. 2 SOUTH WALNUT CREEK BASIN CHEMICAL PRECIPITATION/MICROFILTRATION AND GAC ADSORPTION SYSTEM

4.5.1 Description

4.5.1.1 Surface Water Collection

The surface water collection system proposed for Woman Creek Basin IM/IRA Alternative No. 2 is the same as the system proposed for IM/IRA Alternative No. 1 (Section 4.4.4.1) with the exception of the means for transporting collected seep water to the treatment system. In this case, pipeline transfer of collected seep water the entire distance from the CS-55 and CS-53 sumps to the treatment system (i.e., the South Walnut Creek Basin IM/IRA facility) is proposed. Pipeline transfer over the entire distance is superior to tank truck transfer due to the relatively close proximity of the treatment facility to the 903 Pad and Lip Area. The South Walnut Creek Basin IM/IRA treatment facility is located just to the north of Central Avenue and approximately 300 feet to the east of the Process Boundary fenceline. Pipeline operation will be controlled from an instrument control box installed at the South Walnut Creek Basin treatment facility. The control box will contain sump level indication and pump control instrumentation that will allow a trained operator to monitor water levels in the CS sumps and pump the water from the sumps to the treatment facility.

For cost estimating purposes, it will be assumed that the CS-55 and CS-53 sumps will be pre-cast concrete structures each with a capacity of 5,000 gallons. It is also assumed that double-walled PVC piping will be used to construct an above-ground pipeline connecting the CS sumps to the South Walnut Creek Basin IM/IRA treatment facility. The pipeline will be entirely above-ground except for a section that crosses Central Avenue which will be installed underground. The pipeline will be insulated and heat traced to prevent freezing during the winter months. Leak detection sensors will be strategically placed in the secondary containment cavity of the pipeline and electrically connected to leak alarms located on the control box. Power to operate the sump pumps, heat tracing, and instrumentation will be obtained from existing power lines in the 903 Pad and Lip Area.

4.5.1.2 Surface Water Treatment

The South Walnut Creek Basin IM/IRA Chemical Precipitation/Microfiltration and GAC Adsorption System (Figure 4-5) is proposed for use in treating contaminated Woman Creek Basin seep water. Installation

of the GAC adsorption portion of this treatment facility has been completed and on-line operation began on May 13, 1991. Startup of the chemical treatment and microfiltration unit operations is currently scheduled for

October 1991. The purpose of the Chemical Precipitation/Microfiltration and GAC Adsorption Treatment System is to remove VOC, radionuclide, and metals contaminants from surface waters collected in the South Walnut Creek Basin (EG&G, 1991a).

The South Walnut Creek Basin IM/IRA surface water treatment system is illustrated in Figure 4-5. Chemical treatment involves addition of iron salts and lime to cause coagulation and flocculation of suspended particulates present in the wastewater to produce a filterable ferric hydroxide precipitate or floc. Since the predominant state of radionuclide and metal contaminants in natural waters is particulate, these inorganic contaminants will be removed through enmeshment in the ferric hydroxide floc (EG&G, 1991a). Removal of radionuclides and metals existing in a soluble state may also be achieved during chemical treatment by adsorption to the floc. The floc will be removed from the process stream by cross-flow membrane filtration. The membrane filter is in a shell and tube configuration with the membrane located on the inside of the tubes. Water is pumped through the filter tubes and water passes through the membrane (i.e., permeate) under the force of the process operating pressure. The filters are designed so that clean water will pass through the membrane in a direction perpendicular to the main process flow (i.e. cross-flow filtration). Flow not passing through the membrane will be recycled to the concentration tank. A fraction of the recycle slurry will be bled from the process for solids removal by gravity separation and pressure filtration. The filter press cake is expected to be approximately 30 percent solids by weight, and will be stabilized with the addition of portland cement. The cross-flow filter permeate will be neutralized by the addition of sulfuric acid and will be further processed by GAC adsorption units for removal of VOCs as described below.

Figure 4-5 shows that the GAC Adsorption Treatment System for the South Walnut Creek IM/IRA consists of two on-line GAC units and two on-line, standby GAC units. Each GAC unit is 60 inches high and 87 inches in diameter and contains 2,000 pounds of GAC. The on-line units are operated in series (i.e., lead and polishing positions). Once the GAC in the lead unit is determined to be spent, it is taken out of service. The GAC unit in the on-line, polishing position becomes the new lead unit and one of the on-line, standby units is placed in the on-line, polishing position. "Rotation" of the GAC units into the lead, polishing, and standby positions is accomplished by changing the open/closed configuration of the process valves. Physical movement of unspent GAC units is not necessary. The spent GAC is replaced with a new unit containing virgin GAC. The newly installed unit is immediately placed in the on-line, standby mode. Spent GAC will be analyzed for the presence of radionuclides and for toxicity by the EPA Toxicity Characteristic Leaching Procedure (TCLP). Results of these analytical tests will determine if spent GAC from this process may be regenerated or must be managed as a hazardous mixed waste. As of this writing, the process has not yet generated spent GAC.

The South Walnut Creek Basin IM/IRA surface water treatment system was designed to continuously process surface water influent at a rate of 60 gpm. This flow rate corresponds to the design flows established

Two methods exist for collecting the contaminated Woman Creek Basin seep waters mentioned above. First and foremost is collection of surface water by diversion at the sources. This technique employs existing or newly constructed diversion structures at the seep to divert the surface water into collection sumps. This method of surface water collection was agreed to by EPA, CDH, and DOE in the February and March 1990 meetings. Surface water collection by diversion at the sources has been selected for inclusion in all Woman Creek Basin IM/IRA alternatives considered in this document. This surface water collection technique will be further discussed and evaluated in Section 4.5. For comparative purposes, however, a second surface water collection method is discussed below.

The second method of surface water collection is by ground-water withdrawal using an upgradient well array or french drain. This technique lowers the ground-water table and eliminates seepage, allowing separation of contaminated ground water (seepage) from surface water runoff. However, the hydrogeology at OU 2 is not adequately understood to design an effective ground-water withdrawal system. For example, it is not known whether the seepage is due to water originating in the Rocky Flats Alluvium and being released to the surface through colluvium because of slope changes and/or bedrock highs, or whether the source of the water is bedrock sandstone subcropping in this vicinity. This information is critical to the design of an effective ground-water withdrawal system. EPA alluded to the issue in their transmittal letter (January 9, 1990) that accompanied their comments on the draft OU 2 ground-water IM/IRAP/EA, wherein they stated "... this OU is difficult to address on an interim basis due to the lack of comprehensive quality data characterizing the nature and extent of contamination. It is uncertain whether the most probable imminent threat, the alluvial ground-water system, can be effectively addressed at this time." For this reason, collection of surface water by ground-water withdrawal is eliminated as a reasonable alternative for this IM/IRA, and will not be considered for further detailed evaluation.

4.1.2 Surface Water Treatment

Based on the objectives of the Woman Creek Basin Surface Water IM/IRA discussed in Section 3.1, Table 4-1 has been prepared to establish the design basis for surface water treatment. The effluent concentrations listed in Table 4-1 correspond to the ARARs for each contaminant (refer to Section 3). The influent constituent concentrations listed in Table 4-1 are estimated from a flow-weighted maximum concentration model based on the mean maximum constituent concentrations observed at the 903 Pad and Lip Area seeps and SW-53. The flow-weighted maximum concentrations computed by the model present a very conservative estimate of the actual influent concentrations expected. The flow values used to weight the maximum concentrations are the collection system design flows at SW-55 and SW-53. The collection system design flows are established in Section 4.4. A spreadsheet illustrating computation of the flow-weighted maximum concentration computation is presented in Table G-1, Appendix G. Table G-1 shows that application of the flow-weighted concentration model predicts vinyl chloride, methylene chloride, and acetone influent

TABLE 4-1

BASIS FOR SURFACE WATER TREATMENT*

	Units	Influent Concentration[a]	Effluent Requirements[b]
Volatile Organics			
1,1-Dichloroethene	μg/ℓ	48	7
Carbon Tetrachloride	μg/ℓ	146	5
Trichloroethene	μg/ℓ	245	5
Tetrachloroethene	μg/ℓ	17	10
Dissolved Metals			
Iron (Fe)	mg/ℓ	2.3450	0.300**
Manganese (Mn)	mg/ℓ	0.391	0.050**
Strontium (Sr)	mg/ℓ	0.0084	0.396***
Aluminum (Al)	mg/ℓ	8.9975	8.9975
Beryllium (Br)	mg/ℓ	0.0092	0.005**
Cadmium (Cd)	mg/ℓ	0.0087	0.005
Lead (Pb)	mg/ℓ	0.0059	0.005
Nickel (Ni)	mg/ℓ	0.0232	0.002
Zinc (Zn)	mg/ℓ	0.2660	0.045
Total Metals			
Aluminum (Al)	mg/ℓ	25.59	0.2U**
Beryllium (Be)	mg/ℓ	0.0092	0.005**
Cadmium (Cd)	mg/ℓ	0.0087	0.010
Copper (Cu)	mg/ℓ	0.0277	0.025**
Iron (Fe)	mg/ℓ	14.1850	1.000**
Lead (Pb)	mg/ℓ	0.0118	0.050
Strontium (Sr)	mg/ℓ	0.8710	0.396**
Zinc (Zn)	mg/ℓ	1.0480	0.045**

TABLE 4-1 (Continued)

BASIS FOR SURFACE WATER TREATMENT

	Units	Influent Concentration[a]	Effluent Requirements[b]
Volatile Organics			
Total Radionuclides			
Gross Alpha	pCi/ℓ	150.2	15
Gross Beta	pCi/ℓ	37.9	5 **
Plutonium 239,240	pCi/ℓ	48.9	15
Americium 241	pCi/ℓ	11.2	0.05 **
Total Inorganics			
Total Dissolved Solids	mg/ℓ	560.6	250 **
Chloride	mg/ℓ	53.3	250 **

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* Analytes shown are only those where the ARAR was exceeded in any sampling event. It is noted, however, that all the metals except zinc did not occur above background, i.e., ARARs are more stringent than background concentrations. This is also true for zinc where the background concentration is 0.376 μg/ℓ. Where ARARs exceed background concentrations, an ARAR waiver is appropriate.

** No ARAR standard exists for this constituent; effluent requirement is TBC concentration, considered as an IM/IRA treatment goal.

*** No ARAR or TBC standard exists for this constituent; effluent requirement is background concentration, considered as an IM/IRA treatment goal.

[a] The influent concentrations are based on flow-weighted maximum constituent concentrations of 903 Pad and Lip Area seeps (SW-50, SW-52, SW-55, SW-57, SW-58 and SW-77) and SW-53. The computation is illustrated by the spreadsheet shown in Table G-1, Appendix G. The maximum constituent concentrations for the 903 Pad and Lip Area seeps and SW-53 are multiplied by the collection station design flows at SW-55 and SW-53, respectively. The multiplication products for each collection station are summed and divided by the sum of the CS-55 and CS-53 design flows (4 gallons per minute [gpm]). Concentration data used in the flow-weighted maximum concentration computation is obtained from the 1987, 1988, 1989, and 1990 field investigations.

[b] Based on ARARs. The "U" designation following many of the effluent concentrations indicates that the concentration is the detection limit for that constituent.

concentrations above their respective ARAR values. However, examination of the surface water data presented in Appendix B indicates that for all sampling events at all Woman Creek Basin IM/IRA surface water monitoring stations, vinyl chloride was present above detection limit only once at SW-77. In addition, methylene chloride and acetone have always been estimated below detection limits and/or were also present in the associated laboratory blanks.

Four IM/IRA alternative treatment systems are considered in this plan for removal of VOC, radionuclide, and metals contamination from Woman Creek Basin seep water. In establishing the IM/IRA alternatives, use of existing or planned RFP treatment systems was considered due to the small and seasonal character of the IM/IRA seep flows. All four of the IM/IRA alternatives listed below rely on existing or planned RFP treatment facilities. Two of the alternatives, however, require installation of new treatment units in addition to the use of existing or planned RFP treatment facilities.

The four Woman Creek Basin IM/IRA alternative treatment systems are as follows:

Alternative Treatment System No. 1:

Building 231B Granular Activated Carbon (GAC) Adsorption System/Building 374 Low-Level Wastewater Treatment System.

Alternative Treatment System No. 2:

South Walnut Creek Basin Chemical Precipitation/Microfiltration System and GAC Adsorption System.

Alternative Treatment System No. 3:

Woman Creek Basin Air Stripping System/Building 910 Evaporation System.

Alternative Treatment System No. 4:

Woman Creek Basin Chemical Precipitation and Filtration System/881 Hillside Ground-Water Treatment System.

Alternative No. 1 makes use of two RFP treatment facilities and requires no new treatment units to be constructed for the Woman Creek Basin IM/IRA. Alternative No. 2 includes use of the South Walnut Creek Basin IM/IRA surface water treatment facility and requires only installation of additional influent holding capacity at the facility to accommodate processing of Woman Creek Basin seep water. Alternative Nos. 3 and 4 make use of existing RFP facilities, but also require construction of new Woman Creek Basin treatment units for implementation.

The treatment system alternatives listed above include GAC adsorption, air stripping, and ultraviolet (UV) peroxide oxidation technologies for removal of VOCs; and chemical precipitation/filtration, ion exchange, and evaporation for removal of inorganic contaminants. To prevent fouling and/or performance degradation, these treatment units require pretreatment of the surface water influent for removal of suspended solids. The degree of suspended solids removal required varies with each unit. Ion exchange, for example, is typically more susceptible to particulate fouling than is evaporation. The IM/IRA treatment system alternatives include one of two technologies for removal of suspended solids from surface water influent: fabric filtration and chemical precipitation/filtration. Pretreatment for suspended solids removal is also a vehicle for removal of particulate radionuclide and metals. In the case of chemical precipitation/filtration, this process should facilitate precipitation and adsorption of soluble radionuclides and metals. Each of the IM/IRA treatment system alternatives is further discussed in Sections 4.4 through 4.7.

4.2 IM/IRA ALTERNATIVE EVALUATION PROCESS

This section presents the process that is used to critically evaluate each of the IM/IRA alternatives. The process is based on both CERCLA and NEPA evaluation criteria as set forth in the March 1990 NCP and the draft DOE NEPA Compliance Guidance Manual (DOE, 1988 as revised), respectively. Each of these criteria are examined in detail below. With respect to CERCLA, the document has been prepared to conform with the requirements for an Engineering Evaluation/Cost Analysis (EE/CA) as defined in the NCP (FR Vol. 55, No. 46, 8813; 40 CFR 300.415[b][4]). The goal of NEPA is to ensure that decision-makers are fully informed of the impacts to human health and the environment of a proposed action and all its alternatives, including the No Action Alternative. In order to integrate the requirements of NEPA in this analysis, two additional elements are brought into the analysis:

- A fourth criterion, environmental impacts, is added and given weight equal to each of the other three.
- The No Action Alternative is added to the list of alternatives to be analyzed.

4.2.1 Effectiveness

The criteria for effectiveness evaluation of remedial alternatives include protection and the use of alternatives to land disposal, thus promoting treatment or recycling. Protection includes protection of the community and workers during the remedial action; threat reduction; length of time until protection is achieved; compliance with criteria, advisories, and guidance; risk of potential exposure to residuals remaining on site; and continued reliability over the life of the IM/IRA. In addition, the alternatives will be evaluated with respect to reduction of toxicity, mobility, and volume of wastes per the March 1990 NCP.

4.2.2 Implementability

The criteria for implementability evaluation of remedial alternatives include technical feasibility, availability, and administrative feasibility. Technical feasibility includes the ability to: construct the technology; maintain its operation; meet process efficiencies or performance goals; demonstrate performance; and comply with the Superfund Amendments and Reauthorization Act (SARA) requirement that interim remedial actions should contribute to the efficient performance of a long-term remedial action to the extent practicable. Availability includes the availability of necessary equipment, materials and personnel; availability of adequate off-site treatment, storage, and disposal capacity, if appropriate; and description of post-remedial site controls which will be required at the completion of the action. Administrative feasibility includes the likelihood of public acceptance of the alternative, including site and local concern; coordination of activities with other agencies; and ability to obtain any necessary approvals or permits.

4.2.3 Environmental Impact

The criteria for environmental evaluation of IM/IRA alternatives include DOE NEPA compliance guidelines for terrestrial and aquatic impacts, threatened and endangered species, historical and archeological sites, wetlands and floodplains, cumulative impacts; and air quality, water quality, short- and long-term land productivity, personnel exposures, commitment of resources, and transportation impacts.

The procedural guidance for compliance with NEPA and various related environmental statutes for the proposed actions in this Woman Creek Basin IM/IRAP/EA is found in the *Draft DOE NEPA Compliance Guide* (October, 1988 as revised). Coordination of NEPA compliance procedures with review requirements of other environmental statutes that bear on the NEPA process enhances the probability of complete compliance and achievement of timely implementation of programs and projects.

The *Compliance Guide* is intended to assist DOE staff and contractors by providing the following information on the NEPA process: the processes of related environmental statutes that bear on the NEPA process; the timing relationships between EPA review and review requirements of other environmental statutes; and the NEPA process compliance and development for programs and projects. Regulatory guidance procedures for environmental restoration projects as they relate to air quality, water quality, terrestrial and aquatic impacts, threatened and endangered species, and historic and archaeological sites are discussed in sections 4.2.3.1 through 4.2.3.5. Short- and long-term land productivity, personnel exposures, commitment of resources, transportation impacts, wetland and floodplain impact assessment, and cumulative impacts are discussed in sections 4.2.3.6 through 4.2.3.11.

4.2.3.1 Air Quality

Air quality impacts are addressed by estimating changes in ambient air quality due to the No Action Alternative and the alternative IM/IRAs. Changes in air quality would result from emissions of VOCs (No Action and alternative IM/IRAs), and generation of fugitive dust (alternative IM/IRAs). VOC emissions from the No Action Alternative would produce an insignificant increase in ambient VOC concentrations relative to those resulting from VOC emissions from the RFP which are regulated by CDH.

Air quality impacts from VOCs released during construction activities (e.g., excavation and installation of sumps) would be minimal when compared to the normal operational activity at the RFP. Due to their isolated occurrence in soils and the limited amount of excavation planned for any of the alternative IM/IRAs, the amount of VOCs released during this construction activity are not likely to cause measurable changes in the ambient air quality. Based on sample analyses to date, VOC concentrations in soils in the vicinity of the Woman Creek seeps are insignificant. Consequently, normal construction activities and excavations for the alternative IM/IRAs would release very little, if any, VOCs to the atmosphere. The Phase I RI Report (Rockwell International, 1987a) indicates the possible presence of elevated concentrations of semi-volatile organic chemicals (phthalates) in the soil. Any airborne releases of semi-volatile organic chemicals will be from fugitive dust associated with construction activities and will be controlled by adherence to the SSHSP (see Section 4.2.3.7).

Dermal exposure, inhalation, and inadvertent ingestion of airborne radioactivity and VOCs on fugitive dusts will be analyzed in "Personnel Exposure-Routine Operations". Pollution from engine emissions, fugitive dust generation by vehicles and particulates from tire wear will be analyzed separately in "Transportation Impacts."

With respect to water treatment, surface water would be processed through alternative IM/IRA treatment systems; however, due to low VOC concentrations in the surface water, the proposed treatment systems will not produce measurable VOC emissions. Therefore, no change in the levels of these gases in the ambient air off site is expected. Mixing of chemicals for water treatment or strong acids or bases used for hardware cleaning operations may contribute to odors within the confines of the water treatment facilities and will be controlled by adequate ventilation. These odors would not be noticeable from outside the treatment facilities, nor would they be a hazard to workers in the facility under normal circumstances. Spills of chemicals that might be involved in accident conditions will be administratively controlled by actions specified in the OSA. Considering the above factors, air quality impacts are not further discussed except under personnel exposures and transportation impacts.

4.2.3.2 Water Quality

Impacts to surface water quality resulting from the No Action Alternative or construction activities for the alternative IM/IRAs are evaluated by comparison to background concentrations and chemical-specific ARARs. The quality of effluent discharges from a treatment facility to open water are similarly evaluated. The latter is evaluated under "Effectiveness."

However, as discussed in Section 2.3.5, the water quality data for the SID and Pond C-2 do not provide convincing evidence that the Woman Creek Basin seeps are impacting these waters. Nevertheless, assuming the seeps are impacting water quality of Pond C-2, Table 4-2 shows that the average concentrations in Pond C-2 of potential contaminants identified for the seeps do not exceed background concentrations and/or ARARs. Any alternative IM/IRAs would further reduce these concentrations, provided the seeps are a source for this contamination.

With respect to alternative IM/IRAs, potential impacts to water quality also arise from surface water runoff from disturbed ground surfaces resulting in sediment transport to the SID. However, erosion control measures, as defined in the construction specifications, would prevent any contaminated surface water runoff from entering the SID. Techniques may include, but not be limited to, fiber composite nets, grouted riprock, hydromulching and seeding, erosion bales to prevent runon, and benches, berms, and silt fences to control runoff. The area impacted by the construction would be reseeded immediately upon completion of the project.

Woman Creek basin soils within OU 2 are contaminated with plutonium and americium (Rockwell International, 1989a). Prior to any construction work for the surface water collection system, surveys would be performed to detect any radioactive contamination. Elevated radioactive contamination would be handled in accordance with the SSHSP procedures.

With respect to water treatment, spills of surface water, chemicals, or treatment media associated with operation and maintenance of the systems will be mitigated by use of secondary containment which would likely capture all of the spilled material. Spills of liquids involved in accident conditions will be controlled by actions specified in the OSA. Transport of secondary wastes will be in accordance with standard Plant and project-specific operating procedures and presents a negligible hazard to on-site or off-site water quality. Considering the above factors, water quality impacts are not further discussed.

4.2.3.3 Terrestrial and Aquatic Impacts

Regulations which require federal agencies to assess project impacts on terrestrial and aquatic biota include: NEPA of 1969, the Fish and Wildlife Coordination Act (FWCA) (16 U.S.C. 661-666c), the ESA of 1973 for the South Walnut Creek Basin IM/IRA surface water collection systems. However, design flows are maximum anticipated surface water flows for the collection systems and influent flows from the South Walnut Creek Basin sources will, on the average, be substantially less than 60 gpm. For example, GAC Adsorption System operating data for May and June 1991, two relatively high precipitation months, indicate that on the average the South Walnut Creek Basin sources have produced less than 50 percent of collection system design flows. Nonetheless, prudent utilization of the South Walnut Creek Basin treatment facility to process Woman Creek Basin seep water requires that additional influent storage capacity be provided to ensure that design flows from both basins can be reliably accommodated. It is, therefore, proposed that implementation of Woman Creek Basin IM/IRA Alternative No. 2 include installation of a 20,000-gallon influent storage tank to the South Walnut Creek IM/IRA treatment facility. This additional storage capacity will allow storage of seep water collected by CS-55 and CS-53 at design flow rates (i.e., 4 gpm total) for approximately 3.5 days. In the unlikely event that 100 percent of the treatment system capacity is required for processing South Walnut Creek Basin sources for more than 3.5 days, Woman Creek Basin seep flows will be permitted to overflow the collection sumps and continue downgradient along their pre-IM/IRA pathways. Note also that any incidental throughput capacity limitations that may result from implementing Woman Creek Basin IM/IRA Alternative No. 2 may be easily corrected by modification of the unit operations to increase the maximum throughput capacity of the treatment units.

The treatment technologies that comprise the South Walnut Creek Basin IM/IRA treatment facility (chemical precipitation/microfiltration and GAC adsorption) are well suited for removal of VOCs, radionuclides, and metals that may be present in the Woman Creek Basin seep water. Use of this facility for treating surface water from both the South Walnut and Woman Creek Basins was originally proposed on 26 September 1990 (EG&G, 1990). The proposal included tank truck transport of Woman Creek Basin surface water to the treatment facility via Indiana Street, commingling of collected waters from both basins, treatment, and subsequent discharge of treated water to the South Walnut Creek drainage. However, there was some public opposition to the proposed tank truck transportation route and the discharge of Woman Creek Basin surface water to the South Walnut Creek drainage from a treatment process lacking application-specific performance data (EG&G, 1991). As a result, consideration of collection and treatment of Woman Creek Basin contaminated seep water was deferred. As discussed above, IM/IRA Alternative No. 2 includes pipeline transport of the Woman Creek Basin seep water to the South Walnut Creek treatment facility, thereby eliminating tank truck transport. Implementation of IM/IRA Alternative No. 2 also includes initial "batch" treatment of Woman Creek Basin seep water to establish a radionuclide removal performance data.

Batch processing will involve treating given volumes of Woman Creek Basin seep water separately from South Walnut Creek Basin surface water. The influent and effluent batch-treated water will be analyzed for radionuclides and subsequently transported by tank truck to the SID and discharged. Comparison of radionuclide concentrations in Woman Creek Basin surface water influent with corresponding batch treated effluent data will allow determination of treatment system effectiveness. Upon verification that the South Walnut Creek IM/IRA treatment system successfully reduces radionuclide concentrations in Woman Creek Basin surface water to below ARARs, batch processing will be ceased and treated surface waters from both basins will be discharged to the South Walnut Creek drainage.

For cost estimating purposes, it will be assumed that the 20,000-gallon influent storage tank will be equipped with level indication/high level alarm instrumentation and will be insulated and heated to prevent freezing during the winter months. Power to operate the heat tracing and instrumentation will be obtained from the existing South Walnut Creek Basin IM/IRA treatment system power source. It is also assumed that the performance of the South Walnut Creek Basin IM/IRA treatment facility in removing radionuclides from Woman Creek Basin surface water can be established by processing no more than 10 5,000-gallon batches.

4.5.2 Effectiveness

4.5.2.1 Surface Water Collection

The effectiveness of surface water collection by diversion at the sources is discussed in Section 4.4.2.1. IM/IRA Alternative No. 2 employs a pipeline to transfer surface water collect by CS-55 and CS-53 the entire distance to the proposed South Walnut Creek Basin treatment facility. This method of surface water transfer is superior to the combination pipeline/tank truck transport proposed in IM/IRA Alternative No. 1 in that potential worker exposure to contaminated surface water during tank truck transfers is eliminated.

4.5.2.2 Surface Water Treatment

Chemical Precipitation and Microfiltration Treatment System

The effectiveness of the South Walnut Creek Basin Chemical Precipitation and Microfiltration Treatment System in removing radionuclide and metals contaminants from surface water will be examined in a field treatability study commencing in late 1991. It is expected that this study will be concluded by mid 1992. Based on published performance data for chemical precipitation/cross-flow microfiltration systems, however, the South Walnut Creek Basin IM/IRA treatment facility is expected to be highly effective for removal of suspended solids and inorganic contaminants.

As discussed in Section 4.5.1.2, the South Walnut Creek Basin treatment system includes cross-flow membrane filters. Chemical precipitation and cross-flow membrane filtration is effective at removal of suspended solids. There are numerous applications of this technology in use throughout the United States. Effluent suspended solids concentrations are less than 1 mg/ℓ (Tiepel and Shorr, 1985). Because radionuclides and metals in surface water are largely associated with the suspended solid fraction (see Section 4.4.2.1), simple suspended solids removal is anticipated to remove greater than 99 percent of these constituents. Effluent toxicity is thus significantly reduced in terms of radionuclides and metals, and it is likely that the ARARs will be achieved with the proper chemical feed. Treated water will be monitored to ensure contaminants are within regulatory guidelines. Cross-flow membrane filtration provides reliable and automated surface water treatment service requiring minimal operator intervention. Workers can be easily trained on the safe operation of the unit and handling of dewatered solids. This, together with health and safety design considerations (trailer venting, alarm/emergency shutdown systems, automated clean-in-place equipment, etc.) provides a high degree of worker protection. Filter cake generated by the cross-flow membrane filtration process will be handled according to the RFP standard waste management procedures and operation-specific SOPs.

Although limited, there is data demonstrating the removal of plutonium from water using cross-flow membrane filtration. The only data available is from a study performed at the RFP using a small-scale, cross-flow membrane filtration unit (< 1 gpm) treating plutonium- and uranium-contaminated laundry wastewater. Results are shown below:

Parameter	Concentration (pCi/ℓ) Influent	Effluent
Gross alpha	2,480	5.3
Gross beta	3,933	8.9
Total uranium	1,238	2.25
Plutonium	63.4	0.25

The plutonium removal efficiency indicated by these test results is greater than 99 percent. Other data from previous test runs on laundry waste water indicated effluent plutonium concentrations less than the detection limit (0.1 pCi/ℓ). The data indicate the cross-flow membrane filtration process can meet the ARAR for plutonium of 15 pCi/ℓ. Using the percent plutonium removal for the above reported test and the expected influent concentration of plutonium to the treatment facility, the ARAR will be achieved based on theoretical calculations.

Data demonstrating removal of americium from natural waters is not available at the time of this writing. However, americium's strong affinity for particulates in natural waters suggests that americium should be removed from Woman Creek Basin surface waters by cross-flow membrane filtration via the suspended solids removal mechanisms. This observation is supported by examination of the dissolved and total americium concentrations detected in Woman Creek Basin surface water samples (Appendix B). Examination of these data reveals that there were no instances where dissolved americium concentrations exceeded the ARAR.

Total americium concentrations (i.e., dissolved plus particulate), however, exceeded the ARAR on several occasions.

It would appear that cross-flow membrane filtration should be effective for removal of plutonium and americium as well as other metals from Woman Creek Basin surface water. ARARs should be achieved for plutonium and americium. ARARs for gross alpha and gross beta should also be achieved. The gross alpha activity is suspected to be largely from uranium and particulate forms of plutonium and americium, and the gross beta activity largely from uranium 238 daughters, e.g., thorium 243 and protactinium 234. The thorium and protactinium predominantly exist in the particulate fraction and should be removed by cross-flow membrane filtration via adsorption on iron hydroxide. Although cesium 137, potassium 40, lead 210, and strontium 90 (which are more soluble) also contribute to gross beta activity, the success of the current filtration operation to lower the gross beta concentration at Pond C-2 would indicate that they are not significant contributors to the gross beta activity in Woman Creek Basin. The ARAR for TDS may not be achieved with cross-flow membrane filtration as a result of the addition of ferric sulfate and lime to the process influent.

4.5.3 Implementability

4.5.3.1 Surface Water Collection

The implementability of surface water collection by diversion at the sources is discussed in Section 4.4.3.1. IM/IRA Alternative No. 2 employs a pipeline to transfer surface water the entire distance from the CS sumps to the proposed South Walnut Creek Basin treatment facility. Installation of the portion of the pipeline beneath Central Avenue will require temporary diversion of RFP traffic. Installation of the underground portion of the pipeline during non-business days would, however, mitigate or avoid impacts to Central Avenue traffic.

4.5.3.2 Surface Water Treatment

IM/IRA Alternative No. 2 makes use of the Chemical Precipitation/Microfiltration and GAC Adsorption System which is being installed as part of the South Walnut Creek Basin Surface Water IM/IRA. Use of this facility to process Woman Creek Basin seep water requires the addition of a surface water influent storage tank to the facility to avoid potential process throughout capacity limitations. Ample space exists near the facility to accommodate the additional tank. Tanks possessing the required 20,000-gallon capacity are readily available, and special labor skills are not necessary to install the storage tank with the required secondary containment and freeze protection support systems. Off-site permitted facilities are available for disposal of treatment system residuals (e.g., filter cake).

A high degree of public acceptance is anticipated for IM/IRA Alternative No. 2 with respect to use of existing RFP wastewater treatment resources. This should particularly be true in light of the proposal to initially batch treat Woman Creek Basin seep water to verify process performance.

4.5.4 Environmental Impact

4.5.4.1 Environmental Impacts from Surface Water Collection

The surface water collection system proposed from Woman Creek Basin IM/IRA Alternative No. 2 is the same as the systems proposed for IM/IRA Alternative No. 1 (Section 4.4.1.1) with the exception of the means for transporting collected seep water to the treatment system. In this case, pipeline transfer of collected seep water the entire distance from CS-55 and CS-53 sumps to the treatment system (i.e., the South Walnut Creek Basin IM/IRA facility) is considered. Environmental impacts from excavation, installation, and monitoring are included in Section 4.4.4.1. Construction of a pipeline to the South Walnut Creek treatment facility would have the same type and general order magnitude of impacts as construction of the pipeline from the seeps to the transfer station. Detailed personnel exposure calculations for pipeline construction are presented in Appendix H. Pipeline transfer from the collection sumps to the treatment facility will eliminate the initial tank transfer activity required in IM/IRA Alternative No. 1. Consequently, potential transportation impacts associated with the proposed water collection system would be somewhat lower than those for Alternative No. 1, which are predicted to be very small.

4.5.4.2 Environmental Impacts from Surface Water Treatment

Personnel Exposures

The surface water treatment system for IM/IRA Alternative No. 2 utilizes the proposed South Walnut Creek Basin IM/IRA Treatment Facility. Onsite and offsite personnel exposures during routine operations would range from very low to negligible based on the analysis presented in the South Walnut Creek IM/IRAP/EA Decision Document (DOE EA-0496) and the evaluation in Appendix H. Based on the maximum amount of contaminants potentially available and the dispersible form of the contaminants, the most severe credible accident would be the rupture of the 20,000-gallon storage tank added by this alternative. From Appendix H, the incremental cancer risk to the maximally exposed onsite individual is predicted to be 2×10^{-7}, with a corresponding HI of 8×10^{-5}. Offsite exposures would be negligible.

Commitment of Resources

The surface water treatment proposed for the Woman Creek IM/IRA Alternative No. 2 will not require construction of additional treatment facilities, but will require commitment of resources (equipment and material) for a 20,000-gallon influent storage tank, and electrical wiring, conduit, and mounting brackets. Total capital cost are discussed in Section 4.5.5.

Treatment of contaminated surface water from OU 2 will result in an incremental increase in site pickup and deliveries of spent GAC units and replacement units and chemicals for the pretreatment of water for the chemical precipitation system. Deliveries will be spread out over the course of the year and will be handled by one of the existing Plant chemical suppliers. The very small number of shipments involved for both the GAC units and the chemical precipitation treatment system will result in an insignificant impact to human health.

Off-site transportation impacts associated with the shipment of solidified filter sludge to a mixed waste disposal site, will be very low as determined in DOE (1990b). Relatively low concentrations of contaminants, the physical form of the waste, disposal site waste acceptance criteria, and compliance with DOT packaging and transport requirements all contribute to very low health risks from incident-free shipment and accident events.

Wetland and Floodplains

The surface water treatment system for Woman Creek Basin IM/IRA Alternative No. 2 will not require construction of treatment facilities, or impact any wetlands or floodplains.

Transportation Impacts

Construction transportation impacts for the treatment process will be very small and comparable to IM/IRA Alternative No. 1 because planned treatment facilities will be utilized. Transportation impacts during routine operations will be lower than the very small impacts associated with IM/IRA Alternative No. 1 because the proposed treatment process will eliminate an interprocess tank truck transfer step. Initial operation of the proposed treatment process will require tank truck transfer of treated water (~10 trips) from the treatment facility to the South Intercepter Ditch. Associated impacts are predicted to be negligible. Additional details are discussed in Appendix I.

Cumulative Impacts

Routine processing of the surface water collected from the surface seeps and drainages will result in some additional solid wastes being generated from the site. Generation of sludge cake by the chemical precipitation system is estimated to be a maximum of 70 cubic yards annually. The filter cake will be disposed of off site in a mixed waste disposal site. All gaseous releases will be undetectable off site. None of the materials that may be released are expected to be concentrated by any natural process.

Drying of the semi-solid sludge waste from the treatment system will require an increase in Plant solidification operations to dry and package the waste for transport to a final disposal site. Neither the drying nor packaging requirement will be significant compared to the current workload of the facility. Radionuclide accumulation in the sludge is not expected to exceed exempt quantities by weight, so that shipment of the sludge is not expected to cause any special concern or require unusual controls.

It is estimated that four workers will be involved in routine operation and maintenance of the surface treatment facility. This will have negligible impact on the workload of Plant personnel. In routine operations, these workers will not be exposed to any levels of chemicals or waste stream pollutants that would restrict them from other assignments at the RFP. Cumulative impacts of IAG interim remedial actions assuming implementation of Woman Creek Basin IM/IRA Alternative No. 2 is included in Table 4-10.

4.5.5 Cost

Assumed costs for implementation and operation of IM/IRA Alternative No. 2 are presented in Table 4-11. Most of the capital costs (i.e., equipment, materials, and installation) required for implementation of this alternative are for the surface water collection system. Annual operation and maintenance cost items listed in Table 4-11 for surface water treatment are incremental costs associated with utilization of the South Walnut Creek Basin IM/IRA treatment facility to process the additional surface water influent load from Woman Creek Basin. The incremental cost items include GAC shipping and consumption, spent GAC disposal, coagulation and flocculation agents, and filter cake disposal. The basis of computation of all surface water collection and treatment costs listed in Table 4-11 are presented in the footnotes at the end of the table.

The total capital cost to implement IM/IRA Alternative No. 2 is $237,100. Annual operation and maintenance costs are approximately $29,800. Based on a 30-year operating life, 10 percent interest rate, and a zero salvage value, the present worth of IM/IRA Alternative No. 2 is $518,000.

TABLE 4-10

CUMULATIVE IMPACTS OF IAG INTERIM REMEDIAL ACTIONS ASSUMING IMPLEMENTATION OF WOMAN CREEK BASIN IM/IRA ALTERNATIVE NO. 2

Impact Category	OU 1 Ground-Water IM/IRA 881 Hillside Ground-Water Treatment System	South Walnut Creek Basin Surface Water IM/IRA Chemical Precipitation/ Microfiltration and GAC Adsorption System	Alternative No. 2 South Walnut Creek Basin Chemical Precipitation/ Microfiltration and GAC Adsorption System	Cumulative Impacts
Environmental Impacts				
Aquatic Impacts	None	None	None	None
Threatened and Endangered Species	None	None	None	None
Historic and Archeological Sites	None	None	None	None
Short- and Long-Term Land Productivity	None	None	None	None
Wetland and Floodplain	None	Minimal	Minimal	Minimal
Excavation	10,300 yd^3	None	100 yd^3	10,400 yd^3
Well Drilling	None	None	None	None
Long-Term Considerations				
Interim Removal Action	Approximately 30 years	Approximately 30 years	30 years[1]	N/A
VOC Contamination Removal	Yes	Yes	Yes	N/A
VOC Contaminant Destruction	Yes	Yes[4]	Yes	N/A
Inorganic Contaminant Removal	Yes	Yes	Yes	N/A
Exposure to General Public				
Construction	Yes	No	No	No
Routine	No	No	No	No
Accident	No	No	No	No

TABLE 4-10 (Continued)

CUMULATIVE IMPACTS OF IAG INTERIM REMEDIAL ACTIONS ASSUMING IMPLEMENTATION OF WOMAN CREEK BASIN IM/IRA ALTERNATIVE NO. 2

Impact Category	OU 1 Ground-Water IM/IRA 881 Hillside Ground-Water Treatment System	South Walnut Creek Basin Surface Water IM/IRA Chemical Precipitation/ Microfiltration and GAC Adsorption System	Alternative No. 2 South Walnut Creek Basin Chemical Precipitation/ Microfiltration and GAC Adsorption System	Cumulative Impacts
Exposure to Workers				
Construction	Negligible	Yes	Yes[2]	Yes
Routine	Negligible	Minimal	Minimal	Minimal
Accident	Yes	Yes	Yes	Yes
Off-Site Transportation				
Construction (truckloads)	<10	<5	2	<20
Operation (loads/year)	<5	<5	0	<10
Contaminated Materials (truckloads)	Not Determined	Not Determined	Yes[3]	Not Determined
On-Site Transportation				
Construction (truckloads)	<20	<10	<5	<40
Operation (loads\year)	<10	<10	<5	<30

1 Assuming 7 years as IM/IRA

2 Collection system only

3 Solidified filter cake & disposable GAC unit

TABLE 4-11

ASSUMED COSTS FOR IM/IRA ALTERNATIVE NO. 2
SOUTH WALNUT CREEK CHEMICAL PRECIPITATION/MICROFILTRATION AND GAC ADSORPTION SYSTEM

		CAPITAL COST (DOLLARS)	ANNUAL COST (DOLLARS)
A. EQUIPMENT AND MATERIALS			
Surface Water Collection:			
Quantity	Item		
2	5,000-gallon precast concrete sump	20,000	
2	Sump pump	1,000	
2	Sump level instrumentation	2,400	
3,500 l.f.	Influent pipeline: double-walled, insulated, heat traced PVC piping (design and fabricate)	12,300	
6	Pipeline leak detection sensors	1,800	
3,500 l.f.	Above-ground pipe support structure (design and fabricate)	19,300	
1	Pipeline diverter valve with actuator	3,500	
1	[1]Transfer station control box (design and fabricate)	9,200	
1 lot	Electrical wiring, conduit, mounting brackets	3,500	
Surface Water Treatment:			
Quantity	Item		
1	20,000-gallon influent storage tank	22,000	
1 lot	Electrical wiring, conduit, mounting brackets	300	
B. INSTALLATION			
Surface Water Collection:			
Quantity	Item		
2	[2]Sump installation	6,200	
1	[3]Trench construction	1,800	
3500 l.f.	[4]Influent pipeline and pipeline support structure	15,800	
1 lot	[5]Control box installation, instrumentation and power wiring	6,000	
1 lot	[6]Contaminated soil disposal	37,400	

TABLE 4-11 (Continued)

ASSUMED COSTS FOR IM/IRA ALTERNATIVE NO. 2
SOUTH WALNUT CREEK CHEMICAL PRECIPITATION/MICROFILTRATION
AND GAC ADSORPTION SYSTEM

		CAPITAL COST (DOLLARS)	ANNUAL COST (DOLLARS)
B. INSTALLATION			
Surface Water Treatment:			
1	[7]20,000-gallon influent storage tank with secondary containment	3,000	
Surface Water Collection:			
Quantity	Item		
2	[8]Collection system cleaning		3,800
--	[9]Sediment disposal		1,000
--	[10]Pipeline maintenance		6,300
--	[11]Power		6,600
C. OPERATION AND MAINTENANCE			
Surface Water Treatment:			
Quantity	Item		
--	[12]GAC service		1,800
--	[13]GAC unit shipping		1,100
--	[14]Spent GAC disposal		400
--	[15]Treatment chemicals		1,500
--	[16]Sludge waste disposal		2,300
--	[17]Monitoring and Analysis		---
10	[18]Tank Truck Transport of Batch Effluent	3,800	
	SUBTOTAL	$169,300	$ 24,800
D. ENGINEERING AND CONTINGENCY			
Design at 15% of Total Capital Cost		$25,400	
Construction Management at 5% of Total Capital Cost		8,500	
Contingency at 20%		33,900	5,000
	TOTAL COST	$237,100	$ 29,800

TABLE 4-11 (Continued)

ASSUMED COSTS FOR IM/IRA ALTERNATIVE NO. 2 SOUTH WALNUT CREEK CHEMICAL PRECIPITATION/MICROFILTRATION AND GAC ADSORPTION SYSTEM

E. PRESENT WORTH ANALYSIS		CAPITAL COST (DOLLARS)	ANNUAL COST (DOLLARS)
Present Worth Factor (PWF)	=	9.427 (30 years, 10% i for annual costs)	
$29,800/year @ 9.427	=	$280,900	
1992 Capital Cost	=	$237,100	
		$ 518,000	

1 Transfer station control box includes sump level and pipeline leak detection instrumentation and pump control equipment. Control box is weather-tight, insulated, and heated.

2 Sump installation costs are based on 70 manhours of labor at $60/hr, plus a $2,000 backhoe rental charge.

3 Trench construction (i.e., SW-77 to SW-55) costs are based on 30 manhours of labor at $60/hr.

4 Influent pipeline and pipeline support structure installation costs are based on 260 manhours of labor at $60/hr.

5 Control box installation and instrumentation and power wiring costs are based on 100 manhours of labor at $60/hr.

6 To be conservative in costing, it is assumed that soils excavated for CS sump and trench installation will be disposed as hazardous mixed waste ($450 per cubic yard transportation and disposal cost at the Nevada Test Site). The estimated volume of excavated soils is approximately 43 cubic yards for CS-55 (sump and trench) and 40 cubic yards for CS-53 (sump).

7 Influent storage tank installation costs are based on 50 manhours of labor at $60/hr.Drop shipment of the storage tank by the manufacturer is assumed.

8 Annual CS cleaning (i.e., sediment removal from sumps and trench) costs are based on 64 manhours of labor at $60/hr.

9 To be conservative in costing, it is assumed that recovered CS sediments will be disposed as hazardous mixed waste ($450 per cubic yard transportation and disposal cost at the Nevada Test Site). The estimated cost is based on approximately 2 cubic yards of sediment waste generated annually.

10 Annual pipeline maintenance costs are based on 105 manhours of labor annually at $60/hr.

11 Annual electric power costs are based on two 2-hp sump pumps operated continuously for 120 days/year plus a heat trace load of approximately 40 kw (pipeline and tank) operated continuously for 90 days/year. (Conversion factors: 0.7457 kw/hp, $0.07/kwh).

12 The annual GAC service charge is based on the incremental GAC consumption due to processing Woman Creek Basin surface seep water. For costing purposes, it is assumed that 700,000 gallons of Woman Creek Basin surface seep water will be processed annually at a GAC consumption rate of 1 lb/1000 gallons of water processed. The rental cost of a GAC unit containing 2,000 lbs of GAC is approximately $5,000. The incremental GAC consumption cost is therefore estimated as follows: 700 lbs/2000lbs * $5000 = $1750.

13 The incremental GAC unit shipping cost is estimated in the same manner as incremental GAC service cost in Footnote 6. The cost of one roundtrip shipment of a 2000 lb GAC column is approximately $3000.

14 To be conservative in costing, it is assumed that spent GAC will be disposed as a hazardous mixed waste ($450/cubic yard transportation and disposal cost at the Nevada Test Site). The estimated cost is based on a consumption of approximately 1 cubic yard of GAC/year. (Conversion factors: 29 lbs of GAC/cubic foot, 27 cubic feet/cubic yard).

15 Chemical consumption costs are based on 700,000 gallons of surface seep water processed annually, requiring 0.3 pounds of iron and 1 pound of lime per 1,000 gallons of water treated.

16 To be conservative in costing, it is assumed that vacuum filter cake will be disposed as a hazardous mixed waste ($450 per cubic yard transportation and disposal cost at the Nevada Test Site). Annual production of filter cake is based on 700,000 gallons of surface seep water processed containing approximately 350 ppm of suspended solids plus the chemical additions noted in footnote 14. The filter cake produced is assumed to be 30% solids by weight with a density of 80 lbs/cubic foot (conversion factors: 7.45 gallons/cubic foot, 8.34 pounds of water/gallon).

17 Monitoring and laboratory analytical costs are not included because they are the same for all treatment alternatives considered for the surface water IM/IRA.

18 Tank truck operation costs are based on 10 water transfer trips between the South Walnut Creek IM/IRA treatment facility and the South Interceptor Ditch at 3 hours/transfer trip and $60/hr plus a $200/tank truck rental.

4.6 IM/IRA ALTERNATIVE NO. 3
WOMAN CREEK BASIN AIR STRIPPING SYSTEM/BUILDING 910 EVAPORATION SYSTEM

4.6.1 Description

4.6.1.1 Surface Water Collection

The surface water collection system proposed for Woman Creek Basin IM/IRA Alternative No. 3 is the same as the system proposed for IM/IRA Alternative No. 1 (Section 4.4.1.1). Seep water collected by CS-55 and CS-53 will be pumped to the proposed 903 Pad and Lip Area transfer station (see Figure 4-3) and loaded onto a tank truck for transport to the Woman Creek Basin Air Stripping System located at Building 910. The one-way travel distance between the surface water transfer station to Building 910 is approximately 1.3 miles via Central Avenue, through PA Porthole #1, east on Patrol Road, and Spruce Avenue.

For cost estimating purposes, the same surface water collection system design and operating assumptions made for Woman Creek Basin IM/IRA Alternative No. 1 have also been made for IM/IRA Alternative No. 3.

4.6.1.2 Surface Water Treatment

Figure 4-6 illustrates the surface water treatment systems proposed for Woman Creek Basin IM/IRA Alternative No. 3. The treatment systems include a new air stripping unit dedicated to treatment of Woman Creek Basin surface waters and the Building 910 Evaporation System that is scheduled for installation in the fourth quarter of 1991. The air stripping and evaporation systems will serve to remove VOCs and inorganic contaminants from collected Woman Creek Basin seep water. Each of these treatment systems are described in detail below.

The air stripping system proposed for IM/IRA Alternative No. 3 will be installed outside of Building 910 and will be connected to the evaporation system inside of Building 910 by pipeline. As shown in Figure 4-6, the proposed air stripping system includes a 5,000-gallon flow equalization tank, two fabric filtration units configured in parallel, an air stripping column, and a 55-gallon vapor-phase GAC unit. The fabric filtration units will remove suspended particulates from the surface water that may otherwise foul the air stripping column.

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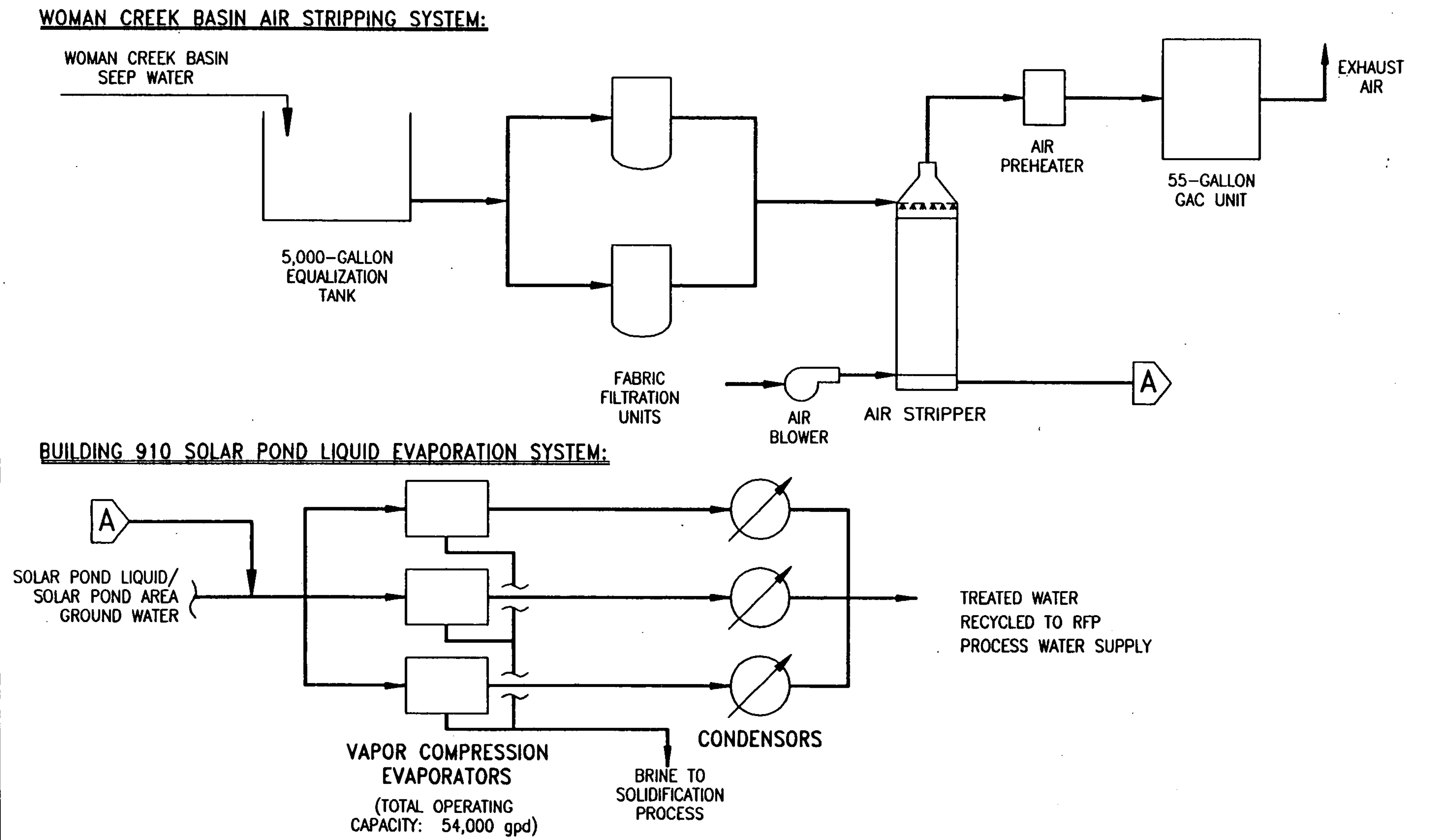

U.S. DEPARTMENT OF ENERGY Rocky Flats Plant Golden, Colorado	IM/IRA ALTERNATIVE NO. 3 WOMAN CREEK BASIN AIR STRIPPING SYSTEM/ BUILDING 910 EVAPORATION SYSTEM (PLANNED)	FIGURE 4-6

Their parallel configuration allows water to be treated with one filter online while filtration media in the other filter is being replaced. Effluent water from the fabric filters will enter the top of a 18-inch diameter, 25-foot air stripping column and subsequently contact clean air supplied to the bottom of the column (column sizes are approximate). Appropriate air-to-water ratios will be utilized to provide for the optimum (99 + percent) transfer of the VOC contaminants from the surface water to the air stream. The air stripper off-gas stream will be heated above its dewpoint and then passed through a 55-gallon vapor-phase GAC unit to remove VOCs before being discharge to the environment. The vapor-phase GAC unit is 36 inches high and 22 inches in diameter and contains approximately 165 pounds of GAC. The treated surface water exiting the bottom of the air stripper will be pumped to the Building 910 Solar Pond Evaporation System and processed as described below. The flow equalization tank and air stripper will be insulated and heated to prevent freezing of process water during the winter months. The fabric filtration units, air preheater, and vapor-phase GAC unit will be installed inside a small insulated, heated trailer located adjacent to the air stripper.

Installation of the Building 910 Evaporation System is currently underway and startup of at least one-third of the system design capacity will occur in October 1991. The remaining two-thirds of processing capacity should be online by the end of the 1991 calendar year. Figure 4-6 indicates that the treatment system will consists of three vapor compression evaporation units configured in parallel. The evaporation units are highly energy efficient with each unit containing 4 stages (heat input) and 3 effects (heat recovery). This design will enable up to 80 percent of the energy input to the evaporator stages to be recovered and used to drive the evaporation process in each of the effects. The operating throughput capacity of each evaporator is 18,000 gallons per day (gpd) (12.5 gpm) for a total system capacity of 54,000 gpd.

Current plans for the Building 910 Evaporation System are that it be initially used to remediate the contaminated water contained in the solar ponds near Building 910. The solar ponds contain approximately 4 million gallons of liquid containing radionuclide and metals contamination. This water will be treated over a period of approximately 12 months. This plan results in a substantial amount of spare processing capacity at the facility which could easily accommodate the surface water influent load from the Woman Creek Basin IM/IRA. After treatment of the solar pond water is complete, the Building 910 Evaporation System will be used for treating groundwater recovered from the Solar Pond Area. Anticipated ground-water flows to the Building 910 Evaporation System have not yet been determined, but are again expected to be much less than the design operating capacity of the facility.

As illustrated in Figure 4-6, the Building 910 Evaporation System will process Woman Creek Basin seep water along with solar pond liquid and/or Solar Pond Area ground water. The evaporators will concentrate radionuclides and metals that may be present in the influent water by boiling off the majority of the water. The steam emerging from the evaporators will be free of inorganic contaminants. The steam will be condensed and recycled to the RFP process water supply. The brine concentrate from the evaporators will be stabilized with the addition of portland cement.

4.6.2 Effectiveness

4.6.2.1 Surface Water Collection

The effectiveness of surface water collection by diversion at the sources is discussed in Section 4.4.2.1.

4.6.2.2 Surface Water Treatment

Woman Creek Basin Air Stripping System

The use of an air stripper is a highly effective method of removing hazardous VOCs from water. The efficiency of the process is well documented. The EPA (*Federal Register*, Vol. 52, No. 130, page 25698) has designated packed tower aeration, along with GAC, as a BDAT for the removal of VOCs from drinking water.

An air stripper coupled with vapor-phase GAC adsorption is a proven system that has a dependable record of use. It is expected that this treatment process, with proper maintenance, will provide the desired level of contaminant removal to meet the ARARs.

The air stripping system is sized for Woman Creek Basin CS design flows (i.e. 4 gpm total) and includes two disposal 55-gallon vapor-phase GAC units — one installed and one stock. The on-site stock unit adds to system reliability. All appropriate safety measures required for moving and installing heavy equipment will be complied with during installation. The operation and maintenance of the system will be performed by personnel property trained in the handling of hazardous and radioactive wastes.

The vapor-phase GAC adsorption unit will remove VOCs from the air stripper emissions before being released to the environment. Therefore, the vapor-phase GAC adsorption unit will eliminate the impact of any air stripper emissions on the public health. The safety of nearby communities should not be adversely affected and the risk of harm to the environment should not be increased. Treated water and air will be monitored to ensure that contaminant levels are below ARARs.

The operators of the Woman Creek Basin Air Stripping System will not be exposed to VOC-laden GAC since direct handling of the GAC is not required. The GAC is containerized in 55-gallon drums, and the units are designed to be disposed when spent rather then regenerated. The operators need only follow routine safety procedures which are appropriate to handling heavy equipment. Permitted off-site facilities are available for disposal of spent GAC units.

Building 910 Evaporation System

The effectiveness of evaporation at concentrating radionuclide and metals contaminants from wastewater is discussed in Section 4.4.2.2.

4.6.3 **Implementability**

4.6.3.1 System Water Collection

The implementability of surface water collection by diversion at the sources is discussed in Section 4.4.3.1. Woman Creek Basin IM/IRA Alternative No. 3 includes tank truck transport of collected surface water from the proposed transfer station (See Figure 4-3) to building 910, which is located within the PA. Implementation of IM/IRA Alternative No. 3 must, therefore, address the security issues associated with vehicular travel into and out of the PA. Coordination with the RFP Security Department as required should avoid unnecessary delays in transporting the Woman Creek Basin seep water to Building 910.

4.6.3.2 Surface Water Treatment

Woman Creek Basin Air Stripping System

Equipment and materials required to construct the air stripping system for Woman Creek Basin IM/IRA Alternative No. 3 are readily available. Operation of the process will be relatively simple, requiring occasional cleaning of the air stripping column and infrequent vapor-phase GAC unit replacement. Air stripper cleaning will involve removal of scale buildup on the column packing material in order to maintain optimum VOC-removal efficiency. Effluent from the cleaning operation will require processing by the Building 374 Low-Level Wastewater Treatment System. Proper operation of the fabric filtration units will avoid unnecessary system downtime resulting from column fouling due to accumulation of solids.

Based on the surface water VOC influent concentrations listed in Table 4-1, vapor-phase GAC consumption will be approximately 0.4 pounds per 1,000 gallons of surface water processed. Assuming that 700,000 gallons of Woman Creek Basin seep water is treated annually, it is estimated that 280 pounds of GAC will be required. This mass of GAC corresponds to 2 55-gallon GAC units. Permitted off-site facilities are available for disposal of spent GAC units.

Air stripping with vapor-phase GAC adsorption should receive a high degree of public acceptance due to its proven track record and BDAT classification.

Building 910 Evaporation System

No new surface water treatment units are required to be added to the Building 910 Evaporation System to accommodate processing of Woman Creek Basin seep water. Building 910 Evaporation System design includes an approximately 40 gpm throughput capacity. It is anticipated that less than 60 percent of the design throughput capacity will be required to treat the solar pond liquid. Processing of Woman Creek Basin seeps is, therefore, easily accommodated by the evaporation system. Permitted off-site facilities are available for disposal of solidified evaporator concentrate.

A high degree of public acceptance is anticipated for use of the Building 910 Evaporation system based on the demonstrated performance of evaporation technology. The public should also strongly support use of RFP wastewater treatment system resources and recycle of treated Woman Creek Basin seep water to RFP operations.

4.6.4 Environmental Impact

4.6.4.1 Surface Water Collection

The surface water collection system proposed for Woman Creek Basin IM/IRA Alternative No. 3 is similar to the system proposed for IM/IRA Alternative No. 1 (Section 4.4.1.1). Potential environmental effects are comparable to those evaluated in Section 4.4.4.1. A more detailed discussion and evaluation of personnel exposures and transportation impacts for IM/IRA Alternative No. 3 are presented in Appendix H and Appendix I, respectively.

4.6.4.2 Surface Water Treatment

Personnel Exposures - Routine Operations Accident Conditions

Onsite and offsite personnel exposures during routine operations would range from very low to negligible as discussed in Appendix H. This IM/IRA alternative would involve the addition of a 5,000-gallon equalization tank adjacent to Building 910. Hypothetical rupture of the tank and complete volatilization of all VOCs would result in an incremental cancer risk of 2×10^{-7} to the maximally exposed onsite individual and a corresponding HI of 4×10^{-3}. Offsite exposures would be negligible.

Commitment of Resources

The scope of the Woman Creek Basin IM/IRA Alternative No. 3 is small and the resources (material/human) for construction and operation of this surface water treatment system will likewise be relatively small. No significant commitments of valuable resources are involved.

With the exception of the land area, all of the materials for construction and operation of the water treatment system will be irrevocably and irretrievably committed to the implementation of the remedial action. Most of these resources are normally consumed at the Plant at a rate which makes the requirements of the remedial action insignificant. The water pretreatment chemicals and cleaning solutions are already in use at the RFP. Process chemicals, cleaning agents, and carbon will all be available within the Denver metropolitan area.

Transportation Impacts

The proposed surface water treatment system would require minor transportation activity to support construction of a new air stripping unit. Subsequent operation of the system would include tank truck transfer of collected surface water to the treatment facility, receipt of process chemicals, and offsite disposal of process byproducts. As discussed in Appendix I, the associated transportation impacts would be very small.

Wetland and Floodplain Impact Assessment

There are no wetlands or floodplains in the proximity of the air stripping facility constructed for Alternative No. 3.

Cumulative Impacts

Routine processing of surface water collected from the seeps and drainages will result in some additional solid wastes being generated at RFP. Generation of brine from the Building 910 evaporation system and the spent GAC units are estimated at a maximum of 110 gallons annually. The GAC units will be shipped to a mixed waste site for final disposal.

It is estimated that four workers will be involved in routine operation and maintenance of the surface water treatment facility. This will have negligible impact on the workload of Plant personnel. In routine operations, these workers will not be exposed to any levels of chemicals or waste stream pollutants that would restrict them from other assignments at the RFP. Cumulative impacts of IAG interim remedial actions assuming implementation of Alternative No. 3 are included in Table 4-12.

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TABLE 4-12

CUMULATIVE IMPACTS OF IAG INTERIM REMEDIAL ACTIONS ASSUMING IMPLEMENTATION OF WOMAN CREEK BASIN IM/IRA ALTERNATIVE NO. 3

Impact Category	OU 1 Ground-Water IM/IRA 881 Hillside Ground-Water Treatment System	South Walnut Creek Basin Surface Water IM/IRA Chemical Precipitation/ Microfiltration and GAC Adsorption System	Alternative No. 3 Woman Creek Basin Air Stripping System/ Building 910 Evaporation System	Cumulative Impacts
Environmental Impacts				
Aquatic Impacts	None	None	None	None
Threatened and Endangered Species	None	None	None	None
Historic and Archeological Sites	None	None	None	None
Short- and Long-Term Land Productivity	None	None	None	None
Wetland and Floodplain	None	Minimal	Minimal	Minimal
Excavation	10,300 yd^3	None	<100yd^3	10,400 yd^3
Well Drilling	None	None	None	None
Long-Term Considerations				
Interim Removal Action	Approximately 30 years	Approximately 30 years	30 years[1]	N/A
VOC Contamination Removal	Yes	Yes	Yes	N/A
VOC Contaminant Destruction	Yes	Yes[4]	Yes	N/A
Inorganic Contaminant Removal	Yes	Yes	Yes	N/A
Exposure to General Public				
Construction	Yes	No	Yes[2]	Yes
Routine	No	No	No	No
Accident	No	No	No	No
Exposure to Workers				
Construction	Negligible	Yes	Yes[2]	Yes
Routine	Negligible	Minimal	Minimal	Minimal
Accident	Yes	Yes	Yes	Yes

TABLE 4-12 (Continued)

**CUMULATIVE IMPACTS OF IAG INTERIM REMEDIAL ACTIONS
ASSUMING IMPLEMENTATION OF WOMAN CREEK BASIN IM/IRA ALTERNATIVE NO. 3**

Impact Category	OU 1 Ground-Water IM/IRA 881 Hillside Ground-Water Treatment System	South Walnut Creek Basin Surface Water IM/IRA Chemical Precipitation/ Microfiltration and GAC Adsorption System	Alternative No. 3 Woman Creek Basin Air Stripping System/ Building 910 Evaporation System	Cumulative Impacts
Off-Site Transportation				
Construction (truckloads)	<10	<5	<5	<20
Operation (loads/year)	<5	<5	<5	<20
Contaminated Materials (truckloads)	Not Determined	Not Determined	1[3]	Not Determined
On-Site Transportation				
Construction (truckloads)	<20	<10	<10	<40
Operation (loads\year)	<10	<10	300	320

1 Assuming 7 years as IM/IRA

2 Collection system only

3 Solidified filter cake & disposable GAC unit

4.6.5 Cost

Assumed costs for implementation and operation of IM/IRA Alternative No. 3 are presented in Table 4-13. Table 4-13 indicates that implementation of IM/IRA Alternative No. 3 requires capital expenditure (i.e., equipment, materials, and installation) for both surface water collection and treatment. Capital costs incurred for surface water treatment are for the Woman Creek Basin Air Stripping System only. Modification of the Building 910 Evaporation System is not necessary. Annual operation and maintenance costs are required for both surface water collection and treatment systems, however. The operating cost listed for the Building 910 Evaporation System (i.e., evaporator fuel costs) is an incremental cost associated with processing the additional surface water influent load from Woman Creek Basin. The basis of computation of all surface water collection and treatment costs listed in Table 4-13 are presented in the footnotes at the end of the table.

The total capital cost to implement IM/IRA alternative No. 3 is $380,100. Annual operation and maintenance costs are approximately $85,400. Based on a 30-year operating life, 10 percent interest rate, and a zero salvage value, the present worth of IM/IRA Alternative No. 3 is $1,185,200.

4.7 IM/IRA ALTERNATIVE NO. 4 WOMAN CREEK BASIN CHEMICAL PRECIPITATION AND FILTRATION SYSTEM/ 881 HILLSIDE GROUND-WATER TREATMENT SYSTEM

4.7.1 Description

4.7.1.1 Surface Water Collection

The surface water collection system proposed for Woman Creek Basin IM/IRA Alternative No. 4 is similar to the system proposed for IM/IRA Alternative No. 2 (Section 4.5.1.1) in that surface water collected by the CS-55 and CS-53 sumps will be transferred to the proposed treatment facilities by pipeline. Treatment facilities for IM/IRA Alternative No. 4 (discussed below in Section 4.7.1.1) are located both outside and inside of Building 891 which is approximately 2,500 feet due west of the proposed location for CS-55. Pipeline transfer over the entire distance is superior to tank truck transport due to the relatively close proximity of Building 891 to the 903 Pad and Lip Area as well as the absence of difficult obstacles that would be necessary to overcome in constructing the pipeline. Pipeline operation will be controlled from a instrument control box installed at Building 891. The control box will contain sump level indication and pump control instrumentation that will allow a trained operator to monitor water levels in the CS sumps and pump the water from the sumps to the treatment facility.

TABLE 4-13

ASSUMED COSTS FOR IM/IRA ALTERNATIVE NO. 3
WOMAN CREEK BASIN AIR STRIPPING SYSTEM/
BUILDING 910 EVAPORATION SYSTEM

A. EQUIPMENT AND MATERIALS		CAPITAL COST (DOLLARS)	ANNUAL COST (DOLLARS)
Surface Water Collection:			
Quantity	Item		
2	5,000-gallon precast concrete sump	20,000	
2	Sump pump	1,000	
2	Sump level instrumentation	2,400	
2,400 l.f.	Double-walled, insulated, heat traced PVC piping (design and fabricate)	8,400	
6	Pipeline leak detection sensors	1,800	
2,400 l.f.	Above-ground pipe support structure (design and fabricate)	13,200	
1	Pipeline diverter valve with actuator	3,500	
100 cu. yd.	Concrete for transfer station pad	12,500	
1	[1]Transfer Station control box (design and fabricate)	9,200	
1 lot	Electrical wiring, conduit, mounting brackets	3,000	
1	5,000-gallon tank truck	70,000	
Surface Water Treatment:			
Quantity	Item		
1	5,000-gallon equalization tank	8,000	
2	Fabric filtration unit	600	
1	Air Stripping Column with air blower	28,000	
1	Air preheater	2,500	
1	Trailer with insulation, lighting, and heating	18,000	

TABLE 4-13 (Continued)

ASSUMED COSTS FOR IM/IRA ALTERNATIVE NO. 3
WOMAN CREEK BASIN AIR STRIPPING SYSTEM/
BUILDING 910 EVAPORATION SYSTEM

		CAPITAL COST (DOLLARS)	ANNUAL COST (DOLLARS)
B. INSTALLATION			
Surface Water Collection:			
Quantity	Item		
2	[2]Sump installation	6,200	
1	[3]Trench construction	1,800	
2,400 l.f.	[4]Pipeline and pipeline support structure installation	10,800	
1 lot	[5]Control box installation, instrumentation and power wiring	4,800	
1 lot	[6]Contaminated soil disposal	37,400	
Surface Water Treatment:			
1	[7]5,000-gallon equalization tank with secondary containment	2,400	
1	[8]Air stripper with secondary containment	3,600	
1	[9]Skid mount fabric filtration units, preheater, and GAC unit inside trailer	2,400	
C. OPERATION AND MAINTENANCE			
Surface Water Collection:			
Quantity	Item		
2	[10]Collection system cleaning		3,800
--	[11]Sediment disposal		1,000
--	[12]Pipeline maintenance		4,300
--	[13]Power		4,400
--	[14]Tank truck operation		30,400
Surface Water Treatment:			
Quantity	Item		
2	[15]55-gallon disposable GAC unit		1,600
2	[16]Spent GAC unit disposal		2,000
--	[17]Power		3,500
--	[18]Monitoring and Analysis		---
--	[19]Operation and Maintenance		18,000
--	[20]Evaporator fuel		2,200
	SUBTOTAL	$271,500	$ 71,200

TABLE 4-13 (Continued)

ASSUMED COSTS FOR IM/IRA ALTERNATIVE NO. 3
WOMAN CREEK BASIN AIR STRIPPING SYSTEM/
BUILDING 910 EVAPORATION SYSTEM

		CAPITAL COST (DOLLARS)	ANNUAL COST (DOLLARS)
D. ENGINEERING AND CONTINGENCY			
Design at 15% of Total Capital Cost		$40,700	
Construction Management at 5% of Total Capital Cost		13,600	
Contingency at 20%		54,300	14,200
	TOTAL COST	$380,100	$ 85,400

E. PRESENT WORTH ANALYSIS

Present Worth Factor (PWF)	=	9.427 (30 years, 10% i for annual costs)
$85,400/year @ 9.427	=	$805,100
1992 Capital Cost	=	$380,100
		$1,185,200

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1 Transfer station control box includes sump level and pipeline leak detection instrumentation and pump control equipment. Control box is weather-tight, insulated, and heated.

2 Sump installation costs are based on 70 manhours of labor at $60/hr, plus a $2,000 backhoe rental charge.

3 Trench construction (i.e., SW-77 to SW-55) costs are based on 30 manhours of labor at $60/hr.

4 Pipeline and pipeline support structure installation costs are based on 180 manhours of labor at $60/hr.

5 Control box installation and instrumentation and power wiring costs are based on 80 manhours of labor at $60/hr.

6 To be conservative in costing, it is assumed that soils excavated for CS sump and trench installation will be disposed as hazardous mixed waste ($450 per cubic yard transportation and disposal cost at the Nevada Test Site). The estimated volume of excavated soils is approximately 43 cubic yards for CS-55 (sump and trench) and 40 cubic yards for CS-53 (sump).

7 Influent storage tank installation costs are based on 40 manhours of labor at $60/hr. Drop shipment of the storage tank by the manufacturer is assumed.

8 Air stripper installation costs are based on 40 manhours of labor at $60/hr. Drop shipment of the air stripper by the manufacturer is assumed.

9 Fabric filtration, air preheater and GAC unit installation costs are based on 40 manhours of labor at $60/hr.

10 Annual CS cleaning (i.e., sediment removal from sumps and trench) costs are based on 64 manhours of labor at $60/hr.

11 To be conservative in costing, it is assumed that recovered CS sediments will be disposed as hazardous mixed waste ($450 per cubic yard transportation and disposal cost at the Nevada Test Site). The estimated cost is based on approximately 2 cubic yards of sediment waste generated annually.

12 Annual pipeline maintenance costs are based on 72 manhours of labor annually at $60/hr.

13 Annual electric power costs are based on two 2-hp sump pumps operated continuously for 120 days/year plus a heat trace load of approximately 25 kw (pipeline and control box) operated continuously for 90 days/year. (Conversion factors: 0.7457 kw/hp, $0.07/kwh).

14 Tank truck operation costs for CS-55 and CS-53 are based on continuous transfer of CS design flow rates for 120 days/year. This conservative assumption for CS operation requires CS-55 and CS-53 to be emptied daily and once every 3 days, respectively. This mode of operation requires that 160 trips/year be made between the transfer station and the treatment system. Assuming 3 hours/transfer, $10 per trip for fuel and maintenance, and a $60/hr labor charge, annual tank truck operation is computed to cost $30,400.

15 GAC consumption costs are based on 700,000 gallons of surface seep water processed annually (CS-55 and CS-53 operating continuously at their design flows for 120 days/year) at a vapor-phase GAC consumption rate of 0.4 lb/1,000 gallons of water processed. The cost of one 55-gallon disposable GAC unit containing 165 lbs of GAC is approximately $800.

16 To be conservative in costing, it is assumed that spent GAC units will be disposed as a hazardous mixed waste ($1,000 per drum transportation and disposal cost at the Nevada Test Site).

17 Power costs are based on a 3 hp blower operated continuously for 120 days/year plus a heating load of approximately 20 kw (tank, air stripper, trailer, and preheater) operated continuously for 90 days/year. (Conversion factors: 0.7457 kw/hp, $0.07/kwh).

18 Monitoring and laboratory analytical costs are not included because they are the same for all treatment alternatives considered for the surface water IM/IRA.

19 Operation and Maintenance costs are for the air stripping system and are based on 25 hours/month at $60/hour.

20 Evaporation fuel costs are based on processing 700,000 gallons of surface seep water annually at a cost of $0.40 per 1,000 standard cubic feet of natural gas. (Conversion factors: 7.48 gallons/cubic foot, 8.34 lbs/gallon of water, 970 BTU required to evaporate 1 pound of water).

For cost estimating purposes, it will be assumed that the CS-55 and CS-53 sumps will be pre-cast concrete structures with each with a capacity of 5,000 gallons. It is also assumed that double-walled PVC piping will be used to construct an above-ground pipeline connecting the CS sumps to the Building 891 treatment facility. The pipeline will be insulated and heat traced to prevent freezing during the winter months. Leak detection sensors will be strategically placed in the secondary containment cavity of the pipeline and electrically connected to leak alarms located on the control box. Power to operate the sump pumps, heat tracing, and instrumentation will be obtained from existing power lines in Building 891 and/or the power lines in the 903 Pad and Lip Area.

4.7.1.2 Surface Water Treatment

Figure 4-7 illustrates the surface water treatment systems proposed for Woman Creek Basin IM/IRA Alternative No. 4. The treatment systems include a new chemical precipitation and filtration system dedicated to treatment of Woman Creek Basin waters and the 881 Hillside Ground-Water Treatment System that is scheduled for installation in March of 1992. The proposed chemical precipitation and filtration system will serve to remove particulate radionuclides and metals contamination from the from collected Woman Creek Basin seep water. The 881 Hillside Ground-Water Treatment System is proposed to remove VOCs and soluble inorganic contaminants from the Woman Creek Basin surface water. Each of these treatment systems are described in detail below.

The chemical precipitation and filtration treatment system proposed for IM/IRA Alternative No. 4 is similar in design to the chemical treatment and filtration unit employed in the Building 374 Low-Level Wastewater Treatment Process. As shown in Figure 4-7, the proposed chemical precipitation and filtration system includes an 8,000-gallon flow equalization tank, two chemical reaction tanks with mixers, a vacuum filter, and a neutralization tank. Chemical treatment involves the addition of iron salts and lime to the influent surface water to create a ferric oxide floc as described in Section 4.4.1.2 for the Building 374 Low-Level Wastewater Treatment System. Radionuclide and metals contaminants present in the surface water in a particulate state tend to be enmeshed in the floc as discussed in Section 4.5.1.2. Removal of radionuclides and metals existing in a soluble state may also be achieved during chemical treatment by adsorption to the floc. The floc will be subsequently removed from the process stream by vacuum filtration. The vacuum filter cake produced will be approximately 30 percent solids by weight and will be stabilized with the addition of portland cement. Filtered water will be neutralized prior to being pumped to the 881 Hillside Ground-Water Treatment System. The Woman Creek Basin Chemical Precipitation and Filtration System will be installed outside of Building 891. The flow equalization tank will be insulated and heated to prevent freezing during the winter months. The chemical reaction tanks, chemical feed systems, vacuum filter and pumps, and neutralization tank will be skid-mounted and installed inside a small insulated, heated trailer located adjacent to the equalization tank. The chemical precipitation and filtration system will be connected to the 881 Hillside Ground-Water Treatment System located inside of Building 891 by pipeline.

The 881 Hillside Ground-Water Treatment System is currently being installed under the ground-water IM/IRA for OU 1. The system was designed to treat groundwater recovered by a french drain that is to be installed in the 881 Hillside. The rate of ground-water recovery is expected to be approximately 5 - 10 gpm and the ground-water contaminants of concern include VOCs, metals, and uranium. The treatment process operating plan includes treatment of collected groundwater at the process design rate of 30 gpm during one 8-hour shift per day. The equipment remains idle throughout the remaining two shifts. Woman Creek Basin seep water may, therefore, be accumulated in the 8,000-gallon influent storage tank and treated during one of the remaining 8-hour shifts.

Figure 4-7 shows that the design of the 881 Hillside Ground-water Treatment System includes UV peroxide oxidation and ion exchange unit operations. A pumped feed system will be used to inject a 50 percent hydrogen peroxide solution into the wastewater influent line. The surface water/hydrogen peroxide mixture will then pass through an in-line static mixer before entering the UV oxidation reactor. In the reactor, the mixture is exposed to UV light to decompose VOCs into carbon dioxide and water.

The effluent from the UV oxidation reactor will then be pumped through fabric filtration units to remove any suspended solids that may be present in the process stream. Dissolved uranium and metal contaminants will then be removed by the anion and cation exchange units, respectively. Regeneration of the anion exchange resin will not be required because of the high affinity and capacity of the resin for uranium. The expected life of the anion exchange units is greater than 30 years at the expected influent flows and uranium concentrations. Although other anions (e.g., chlorides, sulfates) will initially be adsorbed to the resin, the preferential adsorption of uranium will result in displacement of the other anions. The spent resin will ultimately require solidification and disposal as a low-level hazardous waste. The cation exchange resin has a high affinity for high molecular weight metals (e.g., mercury, copper, lead). It is assumed that, unlike the anion exchanger, the cation exchange resin will require regeneration. Effluent from the ion exchange column train is stored in holding tanks pending laboratory analysis results. Upon verification that contaminants have been removed satisfactorily, the treated water is discharged to the SID.

4.7.2 <u>Effectiveness</u>

4.7.2.1 Surface Water Collection

The effectiveness of surface water collection by diversion at the Sources is discussed in Section 4.4.2.1. Woman Creek Basin IM/IRA Alternative No. 4 employs a pipeline to transfer surface water the entire distance from the CS sumps to the proposed treatment systems located at Building 891. This method of surface water transfer is superior to the combination pipeline/tank truck transport proposed in IM/IRA Alternative No. 1 in that potential worker exposure to contaminated surface water during tank truck transfers is eliminated.

4.7.2.2 Surface Water Treatment

Woman Creek Basin Chemical Precipitation and Filtration System

The effectiveness of chemical precipitation and filtration with respect to removal of particulate and dissolved radionuclide and metals contaminants from surface water is discussed in Section 4.4.2.2.

881 Hillside Ground-Water Treatment System

The 881 Hillside UV/peroxide oxidation system is capable of removing VOCs from Woman Creek Basin seep water to levels below ARARs. A technology evaluation of a demonstration unit was conducted by the EPA's Risk Reduction Laboratory in Cincinnati, Ohio (EPA, 1990a). Ground-water treatment experiments were performed in which residence time, ozone and hydrogen peroxide dosages, radiation intensity and influent pH were altered to evaluate the technology. The demonstration unit achieved VOC removals greater than 90 percent. These results indicate that the UV peroxide oxidation treatment process is likely to be capable of achieving the effluent criteria for all of the VOCs listed in Table 4-1. However, in order to avoid incomplete oxidation of the VOCs and the formation of organic degradation products, the peroxide dose and residence time must be carefully controlled.

The system requires periodic UV lamp replacement and routine maintenance, and with such maintenance, the unit is expected to have long-term reliability. The risk of failure of the system at any time is highly unlikely. However, because surface water is expected to have widely varying concentrations of VOCs, it will be difficult to ensure adequate peroxide dosage for complete VOC destruction and to prevent the appearance of excess peroxide in the effluent. While the presence of ferrous iron and manganese can impede the effectiveness of the UV/peroxide treatment system due to the precipitation of these metals, one manufacturer has indicated that this will not be a problem at the iron and manganese concentrations expected. However, should precipitation problems arise, appropriate pre-treatment and post-treatment will be implemented to correct this problem.

The UV/peroxide oxidation system will destroy VOCs present in contaminated Woman Creek Basin surface water and thus represents an alternative to land disposal. The system itself will not produce treatment residuals.

During operation of the UV/peroxide oxidation treatment unit, the use of hydrogen peroxide, a strong oxidizer, will require that operators be aware of this potential hazard. The H_2O_2 bulk storage tank will be properly vented to assure no pressure buildup and minimize handling exposure. Existing DOE and EG&G health and safety guidelines at the RFP and operation-specific SOPs regarding operator safety while working with strong oxidizers will be followed. UV lamps operate utilizing high voltage, and thus caution must be used when working with the system and during the periodic replacement of the UV lamps.

The safety of nearby communities should not be adversely affected, and the risk of harm to the environment should not be increased as this treatment process will effectively destroy the contaminants. Treated water will be monitored to ensure contaminants are within regulatory guidelines before being released to the environment.

The 881 Hillside Ground-Water Treatment System includes both cation and anion exchange units. These resins have been proven to remove heavy metals and uranium, respectively, from wastewater streams to meet ARARs. Information with regard to removal of plutonium and americium by ion exchange does not exist. However, Table 4-1 indicates that these radionuclides are not expected in Woman Creek Basin seep water in a dissolved state above ARARs.

4.7.3 <u>Implementability</u>

4.7.3.1 Surface-Water Collection

The implementability of surface water collection by diversion at the sources is discussed in Section 4.4.3.1.

4.7.3.2 Surface Water Treatment

<u>Woman Creek Basin Chemical Precipitation and Filtration System</u>

Equipment and materials required to construct the chemical precipitation and filtration system for Woman Creek Basin IM/IRA Alternative No. 4 are readily available. Operation of the process will be relatively simple, requiring periodic discharge of filter cake from the vacuum filter. The filter cake will require solidification at the Building 374 treatment facility. Permitted off-site facilities are available for disposal of the solidified filter cake.

Sufficient space outside of Building 891 exists for installation of the influent storage tank and process trailer. No special labor skills are required to install the Woman Creek Basin Chemical Precipitation and Filtration System.

881 Hillside Ground-Water Treatment System

No new surface water treatment units are required to be added to the 881 Hillside Ground-Water Treatment System to accommodate processing of Woman Creek Basin seep water. It is expected that the treatment system will only be required for one shift per day to process ground water recovered from the 881 Hillside. Processing of Woman Creek Basin surface water may, therefore, be conducted during one of the remaining two shifts. The 8,000-gallon influent storage tank included in the Woman Creek Basin Chemical Precipitation and Filtration Treatment System provides for over 30 hours of seep water influent storage capacity at CS-55 and CS-53 design flow rates, and allows scheduling of the treatment system to be utilized as a shared resource.

The performance of the 881 Hillside UV peroxide oxidation unit has not yet been demonstrated. However, UV peroxide oxidation is a technology for the complete destruction and detoxification of hazardous organic compounds in aqueous solutions. Although the technology is relatively new and has had limited application in the field, SARA requires EPA to prefer remedial actions that significantly and permanently reduce the toxicity, mobility, or volume of hazardous wastes by employing innovative technologies that result in the destruction or detoxification of the wastes.

Operating and maintenance requirements for the UV peroxide oxidation treatment system are relatively minor. The system will require up to 350 kilowatts (kw) of power, a high electrical power consumption requirement relative to other treatment processes, and approximately 800 pounds/year of 50 percent H_2O_2 solution to process Woman Creek Basin seep water. Maintenance of the equipment is required. Influent pre-treatment for removal of iron and manganese may be necessary as discussed above. The system will require careful observation to ensure the system is operating properly, although system alarms will notify operators if a problem does occur.

Public acceptance of UV peroxide oxidation should be favorable based on removal efficiencies observed to date. The attribute of mineralizing VOCs present in surface water (i.e., converting them to carbon dioxide and water) should also receive a favorable response. Treatability testing on contaminated Woman Creek Basin surface water may be necessary to win public acceptance of the UV peroxide oxidation system since it is still a relatively new technology.

The performance of the 881 Hillside ion exchange system has not yet been demonstrated. However, it is expected that plutonium, americium, and metals contaminants will be reduced below ARARs during chemical precipitation and filtration pre-treatment. Treatability testing on contaminated Woman Creek Basin surface water may be necessary to win public approval of the ion exchange system.

4.7.4 Environmental Impact

4.7.4.1 Surface Water Collection

The surface water collection system proposed for Woman Creek Basin IM/IRA Alternative No. 4 is similar to the system proposed for IM/IRA Alternative No. 2 (Section 4.5.1.1). Potential environmental effects are comparable to those evaluated in Section 4.4.4.1. A more detailed discussion and evaluation of personnel exposures and transportation impacts for IM/IRA Alternative No. 4 are presented in Appendix H and Appendix I, respectively.

4.7.4.2 Surface Water Treatment

Potential environmental and human health effects resulting from Alternative No. 4 are evaluated in this section.

Aquatic Impacts

The UV peroxide treatment associated with Alternative No. 4 will heat the treated water to approximately 120 degrees F. However, after piping and storage, the released water temperature should be similar to ambient conditions and will not impact aquatic biota.

Personnel Exposures

As with the other IM/IRA Alternatives, potential onsite and offsite exposures during routine operation of the proposed surface water treatment system would range from very low to negligible. Details of the evaluation are presented in Appendix H. Hypothetical rupture of the 8,000 equalization tank added by this alternative and volatilization of all VOCs would result in an incremental cancer risk of 1×10^{-7} to the maximally exposed onsite individual. The corresponding noncancer HI for the same individual is projected to equal 5×10^{-5}.

Commitment of Resources

The commitment of resources (material/manpower) for the Woman Creek Basin IM/IRA Alternative No. 4 are included in Section 4.7.5. With the exception of the land area, all of the construction and operation-related material will be irrevocably and irretrievably committed to the implementation of the remedial action. Most of these resources are normally consumed at the plant at a rate which makes the requirements of the remedial action insignificant. It is expected that ion exchange resins from the water treatment process to remove organic chemicals and the regeneration chemicals will be similar to resins and chemicals already in use on site and discussed in the RFP Final Environmental Impact Statement (DOE, 1980). It is also expected that the resins and regeneration chemicals will be readily available from off-site sources and that the volume of both resins and regeneration chemicals used will not be the cause of shortages in the business community. The anticipated use of hydrogen peroxide and ultraviolet lamps will be well within local supplies.

Transportation Impacts

The proposed surface water treatment system eliminates the need to transfer collected surface water by tank truck on plant site. As discussed in Appendix I, transportation impacts would be very small.

Wetlands and Floodplains

Use of the water treatment facilities at 891 Hillside will not effect wetlands habitats which are sustained by colluvial ground-water flow. The point of return discharge after treatment will be at the upstream (west), end of the 881 Hillside area. Only minimal impacts to the flow of Woman Creek would be expected since the 881 Hillside Area contributes only a small portion of the overall recharge area to the Creek and a portion of the treated water would return to the ground-water system feeding the creek via infiltration from the SID. The return flow rate is anticipated to be on the average of approximately 4 gpm, a volume which would be expected to more likely enhance the wetlands features rather than negatively impact them. The UV/peroxide treatment associated with the proposed action will heat the treated water to approximately 120 degrees F.; however, after piping and storage, the released water temperature should be similar to ambient conditions. Therefore, thermal impacts are also not anticipated. In summary, it has been determined that there will be no significant impact to wetlands if these parameters are maintained. No impacts to wetlands are expected.

No part of the project will be located in a floodplain, and no floodplain impacts are anticipated.

Cumulative Impacts

Routine water processing arising from the treatment of radionuclides, metals, and VOCs would not create significant increase in solid wastes at RFP. All gaseous and liquid releases of contaminants will be essentially undetectable off-site. None of the materials that might be released are expected to be concentrated by any natural processes. Therefore, releases from water treatment will not add to any other plant release to have a cumulative effect. Cumulative impacts from all IAG interim remedial actions are included in Table 4-14.

Treatment of ion exchange resin regeneration waste brine from use of the 881 Hillside facility for OU 2 water will cause a nominal increased load on the Building 374 treatment system. Additional evaporator solids that will be generated will be insignificant. When the resins need to be replaced, they will add a very small amount to current solid waste volumes. None of the chemicals to be collected on the ion exchange resins are defined as hazardous materials in shipping regulations. Any uranium accumulation on the resins is not expected to exceed exempt quantities by weight, so shipment of exhausted resins, if that is required, is not expect to cause any special concerns.

Construction activities will result in increased vehicular traffic, increased engine emissions, and additional workers. The 1980 RFP Environmental Impact Statement (DOE, 1980) notes a yearly loading of 300 additional construction personnel on average. The number of construction personnel required for the proposed action will be a small portion of this assumed yearly construction loading.

Excavation for the chemical precipitation and filtration treatment system may expose small amounts of VOC-contaminated soils at the 891 Hillside area. The airing of such soils will create temporary, low-level releases of contaminant vapors to the atmosphere. Monitoring will be performed in accordance with the Job Safety Analysis. It is unlikely that any measurable concentrations of vapor will be found since the exposed material will be in an unconfined area. The amount of vapor thus releases will be insignificant. Impacts of IAG interim remedial actions assuming implementation of Alternative No. 4 are included in Table 4-14.

4.7.5 Cost

Assumed costs for implementation and operation of IM/IRA Alternative No. 4 are presented in Table 4-15. Table 4-15 indicates that implementation of IM/IRA Alternative No. 4 requires capital expenditure (i.e., equipment, materials, and installation) for both surface water collection and treatment. Capital costs incurred for surface water treatment are for the Woman Creek Basin Chemical Precipitation and Filtration System only. Modification of the 881 Hillside Ground-Water Treatment System is not necessary. Annual operation and maintenance costs are required for both surface water collection and treatment systems, however. The operating costs listed for the 881 Hillside Ground-Water Treatment System (i.e., power, reagent)

TABLE 4-14

CUMULATIVE IMPACTS OF IAG INTERIM REMEDIAL ACTIONS ASSUMING IMPLEMENTATION OF WOMAN CREEK BASIN IM/IRA ALTERNATIVE NO. 4

Impact Category	OU 1 Ground-Water IM/IRA 881 Hillside Ground-Water Treatment System	South Walnut Creek Basin Surface Water IM/IRA Chemical Precipitation/ Microfiltration and GAC Adsorption System	Alternative No. 4 Woman Creek Basin Chemical Precipitation and Filtration/ 881 Hillside Groundwater Treatment System	Cumulative Impacts
Environmental Impacts				
Aquatic Impacts	None	None	None	
Threatened and Endangered Species	None	None	None	None
Historic and Archeological Sites	None	None	None	None
Short- and Long-Term Land Productivity	None	None	None	None
Wetland and Floodplain	None	Minimal	Minimal	Minimal
Excavation	10,300 yd^3	None	$<100 yd^3$	10,400 yd^3
Well Drilling	None	None	None	None
Long-Term Considerations				
Interim Removal Action	Approximately 30 years	Approximately 30 years	30 years[1]	N/A
VOC Contamination Removal	Yes	Yes	Yes	N/A
VOC Contaminant Destruction	Yes	Yes[4]	Yes	N/A
Inorganic Contaminant Removal	Yes	Yes	Yes	N/A
Exposure to General Public				
Construction	Yes	No	Yes[2]	Yes
Routine	No	No	No	No
Accident	No	No	No	No

TABLE 4-14 (Continued)

**CUMULATIVE IMPACTS OF IAG INTERIM REMEDIAL ACTIONS
ASSUMING IMPLEMENTATION OF WOMAN CREEK BASIN IM/IRA ALTERNATIVE NO. 4**

Impact Category	OU 1 Ground-Water IM/IRA 881 Hillside Ground-Water Treatment System	South Walnut Creek Basin Surface Water IM/IRA Chemical Precipitation/ Microfiltration and GAC Adsorption System	Alternative No. 4 Woman Creek Basin Chemical Precipitation and Filtration/ 881 Hillside Groundwater Treatment System	Cumulative Impacts
Exposure to Workers				
Construction	Negligible	Yes	Yes[2]	Yes
Routine	Negligible	Minimal	Minimal	Minimal
Accident	Yes	Yes	Yes	Yes
Off-Site Transportation				
Construction (truckloads)	<10	<5	<5	<20
Operation (loads/year)	<5	<5	<5	<20
Contaminated Materials (truckloads)	Not Determined	Not Determined	1[3]	Not Determined
On-Site Transportation				
Construction (truckloads)	<20	<10	<5	<40
Operation (loads\year)	<10	<10	<5	<30

1 Assuming 7 years as IM/IRA

2 Collection system only

3 Solidified filter cake & disposable GAC unit

are incremental costs associated with processing the additional surface water influent load from Woman Creek Basin. The basis of computation of all surface water collection and treatment costs listed in Table 4-15 are presented in the footnotes at the end of the table.

The total capital cost to implement IM/IRA alternative No. 4 is $296,600. Annual operation and maintenance costs are approximately $80,800. Based on a 30-year operating life, 10 percent interest rate, and a zero salvage value, the present worth of IM/IRA Alternative No. 1 is $1,058,300.

TABLE 4-15

ASSUMED COSTS FOR IM/IRA ALTERNATIVE NO. 4
WOMAN CREEK BASIN CHEMICAL PRECIPITATION AND FILTRATION SYSTEM/
881 HILLSIDE GROUND-WATER TREATMENT SYSTEM

A. EQUIPMENT AND MATERIALS		CAPITAL COST (DOLLARS)	ANNUAL COST (DOLLARS)
Surface Water Collection:			
Quantity	Item		
2	5,000-gallon precast concrete sump	20,000	
2	Sump pump	1,000	
2	Sump level instrumentation	2,400	
4,000 l.f.	Influent pipeline: double-walled, insulated, heat traced PVC piping (design and fabricate)	14,000	
6	Pipeline leak detection sensors	1,800	
4,000 l.f.	Above-ground pipe support structure (design and fabricate)	22,000	
1	Pipeline diverter valve with actuator	3,500	
1	[1]Transfer station control box (design and fabricate)	9,200	
1 lot	Electrical wiring, conduit, mounting brackets	5,000	
Surface Water Treatment:			
Quantity	Item		
1	8,000-gallon influent storage tank	10,000	
2	1,000-gallon reaction tank with mixer	3,600	
1	Lime slurry system including tank, mixer, recirculation pump, and metering pump	7,500	
1	Powdered chemical system including tank, mixer, and metering pump	5,000	
1	Vacuum filtration unit	4,500	
2	30 gpm vacuum filtration pump	1,200	
1	500-gallon neutralization tank with mixer	800	

TABLE 4-15 (Continued)

ASSUMED COSTS FOR IM/IRA ALTERNATIVE NO. 4
WOMAN CREEK BASIN CHEMICAL PRECIPITATION AND FILTRATION SYSTEM/
881 HILLSIDE GROUND-WATER TREATMENT SYSTEM

Surface Water Treatment:		CAPITAL COST DOLLARS	ANNUAL COST DOLLARS
Quantity	Item		
3	pH controller	6,600	
1	Trailer with insulation, lighting, and heating	18,000	
1 lot	Electrical wiring, conduit, mounting brackets	300	
B. INSTALLATION			
Surface Water Collection:			
Quantity	Item		
2	[2]Sump installation	6,200	
1	[3]Trench construction	1,800	
4,000 l.f.	[4]Influent pipeline and pipeline support structure	18,000	
1 lot	[5]Control box installation, instrumentation and power wiring	6,000	
1 lot	[6]Contaminated soil disposal	37,400	
Surface Water Treatment:			
1	[7]8,000-gallon storage tank with secondary containment	2,400	
1	[8]Skid mount reaction tanks, chemical feed systems, vacuum filtration unit, and neutralization tank inside trailer	3,600	

TABLE 4-15 (Continued)

ASSUMED COSTS FOR IM/IRA ALTERNATIVE NO. 4
WOMAN CREEK BASIN CHEMICAL PRECIPITATION AND FILTRATION SYSTEM/
881 HILLSIDE GROUND-WATER TREATMENT SYSTEM

C. OPERATION AND MAINTENANCE			CAPITAL COST (DOLLARS)	ANNUAL COST (DOLLARS)
Surface Water Collection:				
Quantity	Item			
2	9Collection system cleaning			3,800
--	10Sediment disposal			1,000
--	11Pipeline maintenance			7,200
--	12Power			8,900
Surface Water Treatment:				
Quantity	Item			
--	13Treatment chemicals			1,500
--	14Sludge waste disposal			2,300
--	15Monitoring and Analysis			---
--	16Power			24,200
--	17Hydrogen peroxide			400
--	18Operation and maintenance			18,000
		SUBTOTAL	$211,800	$ 67,300
D. ENGINEERING AND CONTINGENCY				
Design at 15% of Total Capital Cost			$31,800	
Construction Management at 5% of Total Capital Cost			10,600	
Contingency at 20%			42,400	13,500
		TOTAL COST	$296,600	$ 80,800

E. PRESENT WORTH ANALYSIS

Present Worth Factor (PWF)	=	9.427 (30 years, 10% i for annual costs)
$80,800/year @ 9.427	=	$761,700
1992 Capital Cost	=	$296,600
		$1,058,300

TABLE 4-15 (Continued)

ASSUMED COSTS FOR IM/IRA ALTERNATIVE NO. 4
WOMAN CREEK BASIN CHEMICAL PRECIPITATION AND FILTRATION SYSTEM/
881 HILLSIDE GROUND-WATER TREATMENT SYSTEM

1 Transfer station control box includes sump level and pipeline leak detection instrumentation and pump control equipment. Control box is weather-tight, insulated, and heated.

2 Sump installation costs are based on 70 manhours of labor at $60/hr, plus a $2,000 backhoe rental charge.

3 Trench construction (i.e., SW-77 to SW-55) costs are based on 30 manhours of labor at $60/hr.

4 Influent pipeline and pipeline support structure installation costs are based on 300 manhours of labor at $60/hr.

5 Control box installation and instrumentation and power wiring costs are based on 100 manhours of labor at $60/hr.

6 To be conservative in costing, it is assumed that soils excavated for CS sump and trench installation will be disposed as hazardous mixed waste ($450 per cubic yard transportation and disposal cost at the Nevada Test Site). The estimated volume of excavated soils is approximately 43 cubic yards for CS-55 (sump and trench) and 40 cubic yards for CS-53 (sump).

7 Influent storage tank installation costs are based on 40 manhours of labor at $60/hr. Drop shipment of the storage tank by the manufacturer is assumed.

8 Reaction tank, chemical feed system, vacuum filter, and neutralization tank installation costs are based on 60 manhours of labor at $60/hr.

9 Annual CS cleaning (i.e., sediment removal from sumps and trench) costs are based on 64 manhours of labor at $60/hr.

10 To be conservative in costing, it is assumed that recovered CS sediments will be disposed as hazardous mixed waste ($450 per cubic yard transportation and disposal cost at the Nevada Test Site). The estimated cost is based on approximately 2 cubic yards of sediment waste generated annually.

11 Annual pipeline maintenance costs are based on 120 manhours of labor annually at $60/hr.

12 Annual electric power costs are based on two 2-hp sump pumps operated continuously for 120 days/year plus a heat trace load of approximately 55 kw (pipeline, tank, and trailer) operated continuously for 90 days/year. (Conversion factors: 0.7457 kw/hp, $0.07/kwh).

13 Chemical consumption costs are based on 700,000 gallons of surface seep water processed annually, requiring 0.3 pounds of iron and 1 pound of lime per 1,000 gallons of water treated.

14 To be conservative in costing, it is assumed that vacuum filter cake will be disposed as a hazardous mixed waste ($450 per cubic yard transportation and disposal cost at the Nevada Test Site). Annual production of filter cake is based on 700,000 gallons of surface seep water processed containing approximately 350 ppm of suspended solids plus the chemical additions noted in footnote 14. The filter cake produced is assumed to be 30% solids by weight with a density of 80 lbs/cubic foot (conversion factors: 7.45 gallons/cubic foot, 8.34 pounds of water/gallon).

15 Monitoring and laboratory analytical costs are not included because they are the same for all treatment alternatives considered for the surface water IM/IRA.

16 Power costs are based on a chemical precipitation and filtration process power requirement of 10 kw and an 881 Hillside Treatment System power requirement of 350 kw operated for 120 eight hour shifts.

17 Hydrogen peroxide consumption costs are on 700,000 gallons of surface seep water processed annually requiring 1.16 lbs hydrogen peroxide per 1000 gallons of surface water at $0.52/lb of hydrogen peroxide.

18 Operation and maintenance costs are for the chemical precipitation/filtration process and are based on 25 manhours/month at $60/hour.

SECTION 5

COMPARATIVE ANALYSIS

The assessment of the No Action Alternative presented in Section 4.3 indicated that the contaminated Woman Creek Basin IM/IRA seeps do not present a significant risk to the public health or the environment. Thus, the need to conduct an IM/IRA for collection and treatment of Woman Creek Basin seep water prior to commencement of final OU 2 remedial action has not been established. Final remedial action at OU 2 is scheduled to be completed within 7 years. The No Action Alternative is, therefore, selected as the "preferred IM/IRA" for Woman Creek Basin. Implementation of the No Action Alternative includes continued environmental monitoring in Woman Creek Basin. In the event that future environmental sampling and analysis results indicate that the Woman Creek Basin seeps may potentially pose future risks to the public health and the environment, the need for collection and treatment of these seeps under an IM/IRA will be re-evaluated.

This section summarizes the results of the evaluations of the IM/IRA surface water collection and treatment alternatives presented in Sections 4.4 through 4.7. The summary is presented by tabular comparison of the evaluation results (Table 5-1). This comparative analysis will aid in the selection of a surface water collection and treatment alternative for Woman Creek Basin seeps if it becomes necessary in the future.

SECTION 6

RECOMMENDED ACTION

The subject Interim Measures/Interim Remedial Action Plan/Environmental Assessment (IM/IRAP/EA) addresses contaminated surface water seeps in a portion of the Woman Creek drainage basin located within OU 2. Because there is no immediate threat to public health and the environment posed by this surface water contamination, and the seeps are not exacerbating environmental contamination, the No Action Alternative has been determined to be the preferred alternative. Remediation of contaminated seepage will await the final remedial action for OU 2, scheduled to be completed within 7 years. This decision is in accordance with the EPA's OSWER Directive 9355.0-30 which states that an interim remedial action should be based on the presence of contamination, if left unaddressed in the short term, either contributes immediate risk or is likely to contribute to increased site risk or degradation of the environment/natural resources. Also, the OSWER Directive states that, in cases where the cumulative carcinogenic site risk to an individual based on reasonable maximum exposure is less than 10^{-4}, the non-carcinogenic hazard index (HI) is less than 1 and there are no adverse environment impacts, remedial action is generally not warranted. Calculations, assuming an unlikely and highly conservative exposure scenario, indicate public health risks resulting from seeps is significantly less than 10^{-4}, or 1 in the case of HI. Actual public health risks are not significant and approach zero. The basis for these conclusions has been previously explained in Sections 2.3.5 and 4.3. The key points of this assessment will be summarized here and include potential impacts of seep contamination on:

- Extent of Soil and Ground-Water Contamination
- Air Quality
- Water Quality
- Aquatic Ecosystems
- Terrestrial Ecosystems
- Wetlands and Floodplains
- Worker Exposure
- Commitment of Resources
- Transportation
- Cumulative Impacts

It should be pointed out that the assumptions under which the assessment has been made are very conservative. This means the likelihood that exposures will equal or exceed the evaluated scenarios is very low.

6.1 EXTENT OF SOIL AND GROUND WATER CONTAMINATION

The Woman Creek seeps do not appear to be exacerbating environmental contamination arising from the 903 Pad Area. The chemical data support that the surface water and sediments of the SID, and Pond C-2 water are not impacted by the seeps. The flow of contaminated surface water seepage is confined to an area of significant surface soil plutonium contamination and ground-water VOC contamination. Therefore, the existence of the seeps is not resulting in more extensive soil or ground-water contamination in this area.

6.2 AIR QUALITY

The exposure scenario evaluated for the no action alternative assumes that all volatile contaminants emerging from the seeps are volatilized, transported, and dispersed to the property line at Indiana Street, and inhaled by a member of the public over the course of 10 years. Even with this very conservative scenario, the calculated HI risk is only 5.5E-07, which is less than one ten-thousandths of a percent of the value which could result in a significant potential for noncarcinogenic health effects. The calculated carcinogenic risk is 1.0E-09 which is well below the value of 1.0E-04 used by the EPA to establish the need for remediation (OSWER Directive 9355.0-30).

6.3 WATER QUALITY

As discussed earlier, it is unlikely that water flowing from the seeps enters the SID which directs flow into Pond C-2. However, the calculation of noncarcinogenic and carcinogenic health risks assumes that all contamination in Pond C-2 originates from the Woman Creek Basin seeps and that 2 liters of untreated Pond C-2 water is ingested daily. The HI and cumulative carcinogenic health risks computed from this highly unlikely exposure scenario are 1.1E-02 and 6.3E-07, respectively. As with the air exposure pathway, the water pathway risks are well below the level used by the EPA to establish the need for remediation.

6.4 AQUATIC ECOSYSTEMS

The concentration of plutonium in Pond C-2 is low, and even somewhat higher concentrations would not be expected to adversely affect aquatic life. The concentration of plutonium in Pond C-2 is 0.02 pCi/ℓ is below the WQCC state-wide standard (15 pCi/ℓ). Work by Whicker et al. (1990) at the RFP confirmed the concept that plutonium tends to reside entirely in sediments, and does not biomagnify.

Many of the VOCs found at OU 2 are known to cause acute and chronic effects on aquatic life depending on the concentration (e.g., carbon tetrachloride, trichlorethene, and tetrachloroethene). However, concentrations of organic compounds in Pond C-2 are well below federal water quality criteria (acute and chronic) for the protection of aquatic life. In general, VOCs are of greater concern from a public health perspective than they are in terms of effects on aquatic life.

6.5 TERRESTRIAL ECOSYSTEMS

It is not possible to specifically quantitate potential terrestrial impacts from Woman Creek seeps. However, the terrestrial risks are not expected to be much different than the calculated human health risks. Furthermore, the calculated human health risks are very conservative since they are estimated from EPA reference doses for VOC chemicals with uncertainty factors ranging from 100 to 1,000. These uncertainty factors can be interpreted as equivalent to safety factors. Safety factors from 100 to 1,000 should be more than adequate to compensate for interspecies variation. Threats to terrestrial ecosystems from VOCs are also minimized due to their tendency to volatilize.

Radioecology studies at RFP (Whicker, 1979) suggest that plutonium has extremely low biological mobility. Therefore, the extremely low levels of plutonium in the seeps are not expected to bioaccumulate to a significant level.

6.6 PERSONNEL EXPOSURES

The no action alternative will have minimal impact on current workers involved in the Woman Creek Basin or adjacent RFP sites. Workers will continue to monitor surface water stations which will not present any additional impacts. Workers will continue to follow appropriate DOE safety orders providing for occupational health and safety (DOE, 1988).

6.7 COMMITMENT OF RESOURCES

The no action alternative would require current monitoring of the Woman Creek seeps and surface waters of the SID and Pond C-2 to be continued over the next 7 years, or until final remediation is implemented. Since monitoring is part of the existing RFP environmental monitoring program, there will be no additional impact on plant operations and the surrounding community.

6.8 TRANSPORTATION IMPACTS

The no action alternative would not involve any impacts to the work force and would eliminate the need for any on-site or off-site transportation activities.

6.9 WETLAND AND FLOODPLAIN IMPACT ASSESSMENT

The no action alternative would not involve any short-term impacts to wetlands or floodplains.

6.10 CUMULATIVE IMPACTS

The no action alternative will not cause additional on-site or off-site exposures.

It should be reiterated that the no action alternative will require monitoring of the Woman Creek seeps and surface waters of the SID and Pond C-2 to be continued. Therefore, if significant changes in contamination occurs that appears to be due to the Woman Creek seeps, human health and environmental risks can easily be re-evaluated as well as the need for an IM/IRA. Unless this re-evaluation results in the calculation of unacceptable risks arising form the seeps, implementation of alternatives other than the no action alternative is considered to be inappropriate.

SECTION 7

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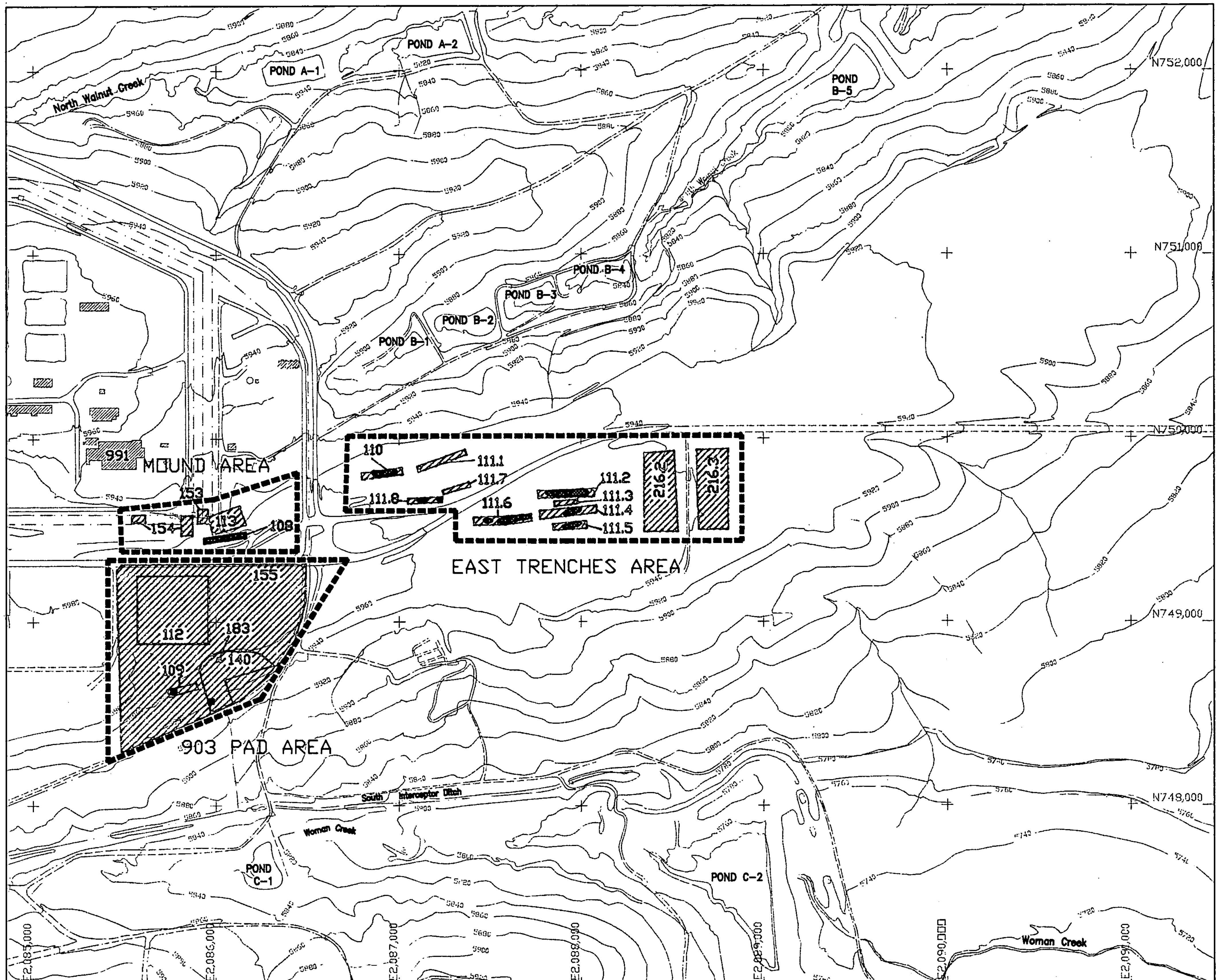

EXPLANATION

216.2 INDIVIDUAL HAZARDOUS SUBSTANCE SITE (IHSS) AND IHSS DESIGNATION

LOCATION OF BARRELS DETERMINED BY VISUAL INSPECTION OR MAGNETOMETER SURVEY

REMEDIAL INVESTIGATION AREAS

N

Scale: 1" = 600'

0' 300' 600'

CONTOUR INTERVAL = 20'

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SURFACE WATER IM/IRA
WOMAN CREEK BASIN

FIGURE 2-2

REMEDIAL INVESTIGATION AREAS AND INDIVIDUAL HAZARDOUS SUBSTANCE SITES

September 1991

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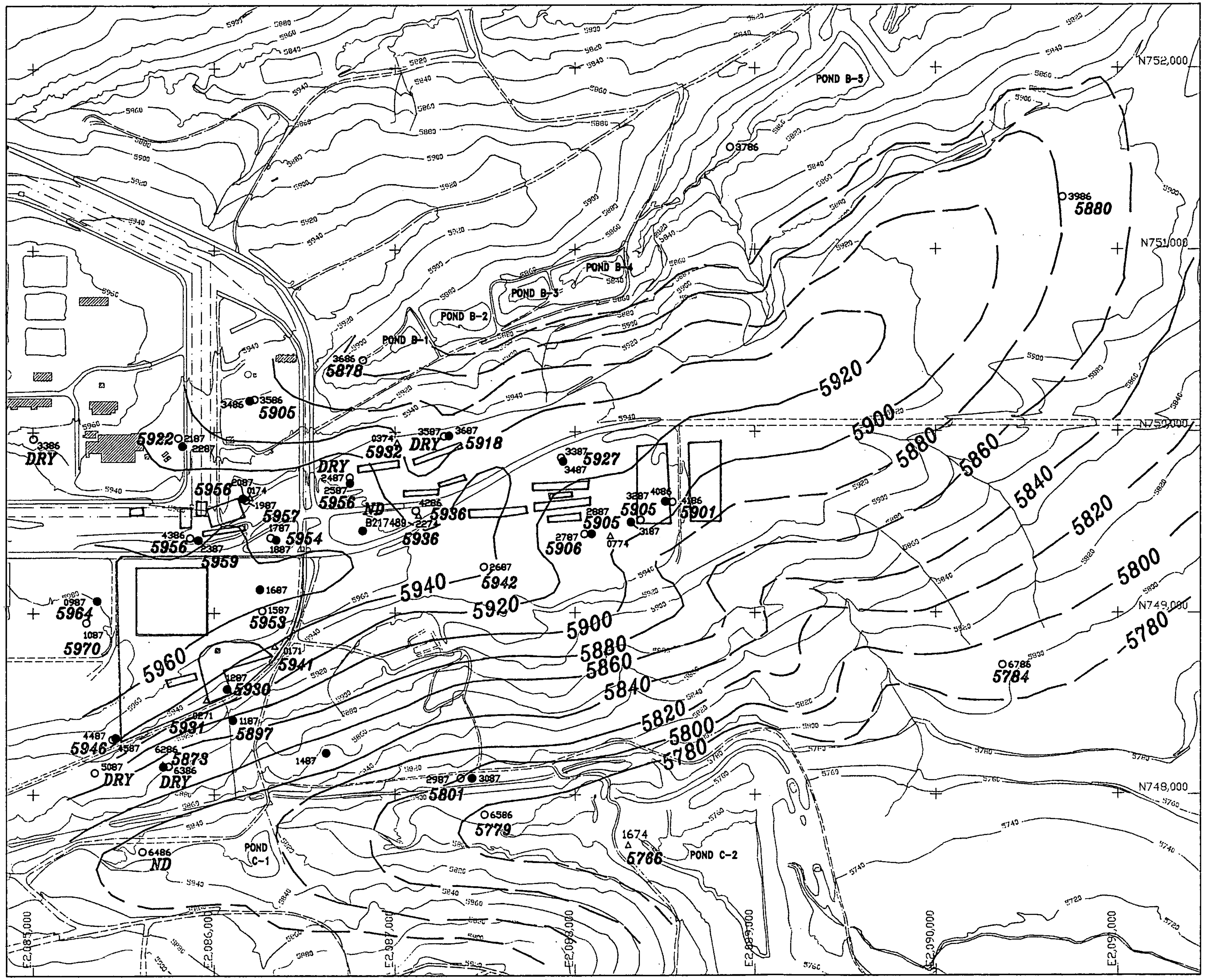

EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITE (IHSS)

5798 POTENTIOMETRIC SURFACE ELEVATION (feet above mean sea level)

ALL DATA BASED ON MEASUREMENTS MADE APRIL 4–8, 1988 INCLUSIVE

5860 LINE OF EQUAL POTENTIOMETRIC SURFACE ELEVATION (feet above mean sea level)—DASHED WHERE APPROXIMATELY LOCATED

ND NO DATA

2587 ● BEDROCK MONITOR WELL

3789 ○ ALLUVIAL MONITOR WELL

0382 △ PRE-1986 MONITOR WELL

N

Scale: 1" = 600'

0' 300' 600'

CONTOUR INTERVAL = 20'

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WOMAN CREEK BASIN

FIGURE 2-7

POTENTIOMETRIC SURFACE OF THE UNCONFINED GROUND-WATER FLOW SYSTEM

September 1991

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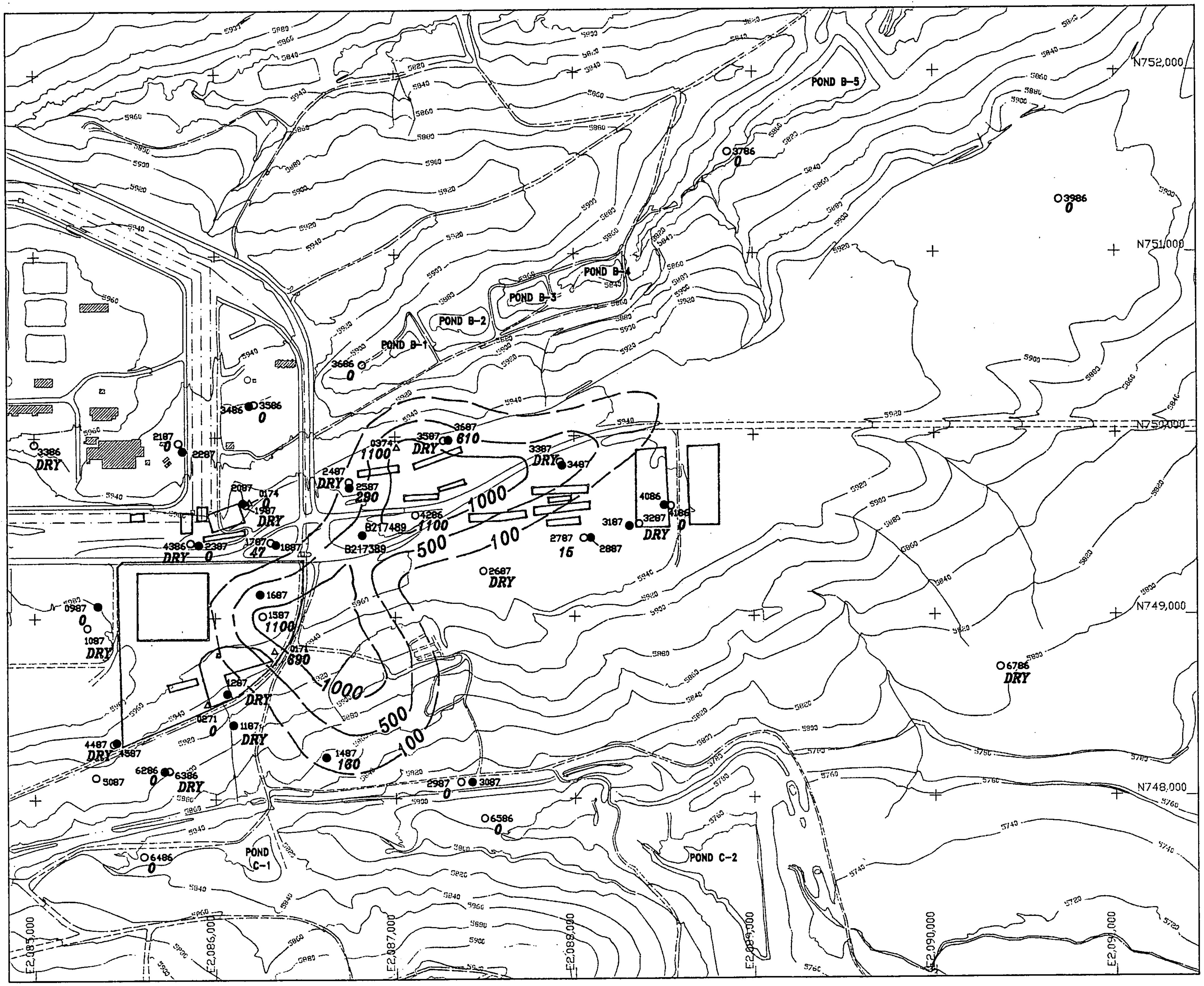

EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITE (IHSS)

500 — LINE OF EQUAL CCl_4 CONCENTRATION (µg/l) DASHED WHERE APPROXIMATELY LOCATED

290 — CCl_4 CONCENTRATION (µg/l)

2587 ● BEDROCK MONITOR WELL

3789 ○ ALLUVIAL MONITOR WELL

0382 △ PRE-1986 MONITOR WELL

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WOMAN CREEK BASIN

FIGURE 2-9

CARBON TETRACHLORIDE ISOPLETHS FOR THE UNCONFINED GROUND-WATER FLOW SYSTEM
Second Quarter 1989

September 1991

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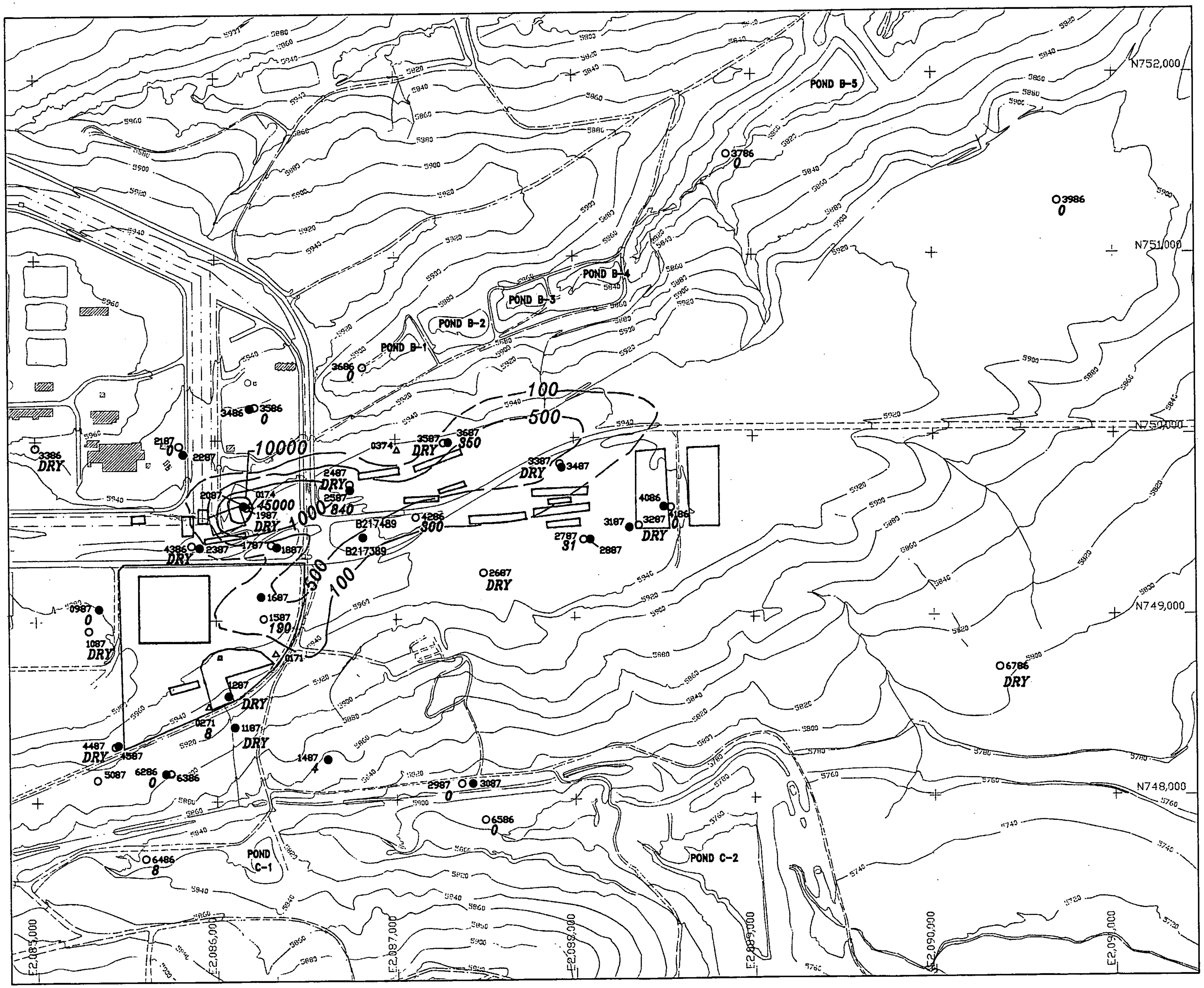

EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITE (IHSS)

500 LINE OF EQUAL PCE CONCENTRATION (μg/l) DASHED WHERE APPROXIMATELY LOCATED

180 PCE CONCENTRATION (μg/l)

2587 ● BEDROCK MONITOR WELL

3789 ○ ALLUVIAL MONITOR WELL

0382 △ PRE-1986 MONITOR WELL

N

Scale: 1" = 600'

0' 300' 600'

CONTOUR INTERVAL = 20'

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WOMAN CREEK BASIN

FIGURE 2-10

TETRACHLOROETHENE ISOPLETHS FOR THE UNCONFINED GROUND-WATER FLOW SYSTEM
Second Quarter 1989

September 1991

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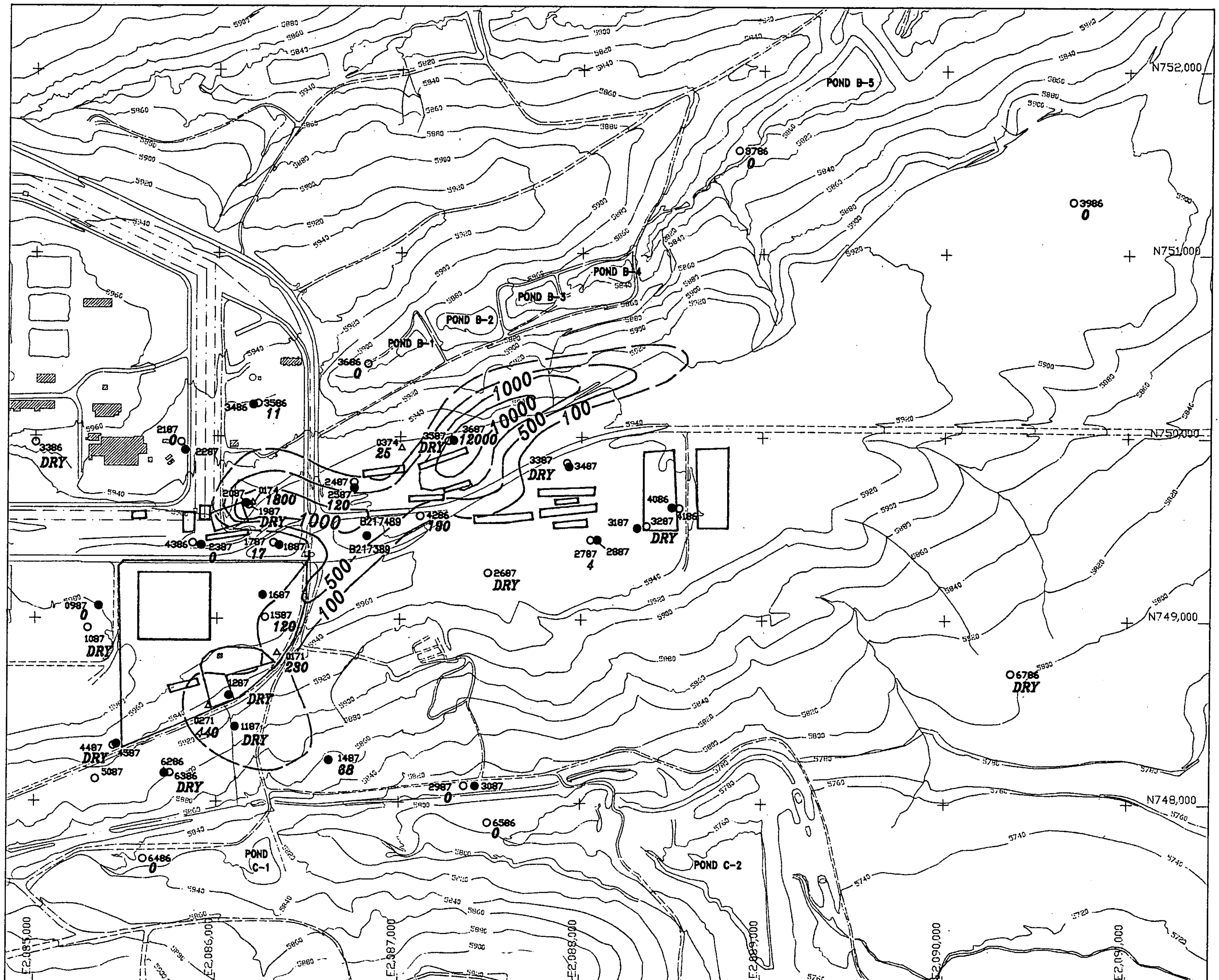

EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITE (IHSS)

500 LINE OF EQUAL TCE CONCENTRATION (μg/l) DASHED WHERE APPROXIMATELY LOCATED

120 TCE CONCENTRATION (μg/l)

2587 ● BEDROCK MONITOR WELL

3789 ○ ALLUVIAL MONITOR WELL

0382 △ PRE-1986 MONITOR WELL

N

Scale: 1" = 600'

0' 300' 600'

CONTOUR INTERVAL = 20'

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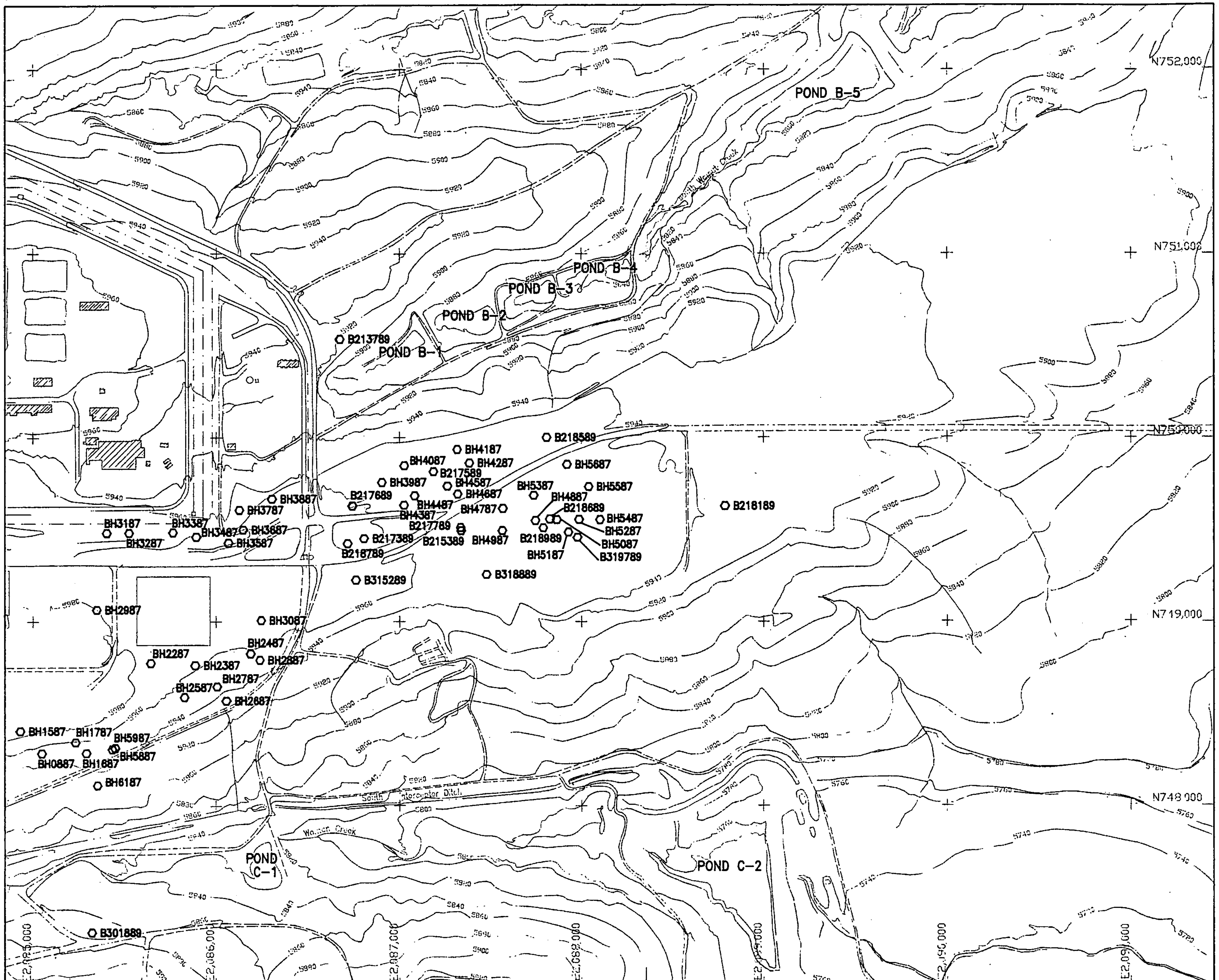
WOMAN CREEK BASIN

FIGURE 2-11

TRICHLOROETHENE ISOPLETHS
FOR THE UNCONFINED GROUND-WATER
FLOW SYSTEM
Second Quarter 1989

September 1991

R37M007.MB070591/600



EXPLANATION

○ BH3087 BOREHOLE LOCATION AND SOIL SAMPLE SITE (REFER TO TABLES A-10 THROUGH A-13)

N

Scale: 1" = 600'

0' 300' 600'

CONTOUR INTERVAL = 20'

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FIGURE 2-12

SOIL SAMPLING
LOCATION MAP

September 1991

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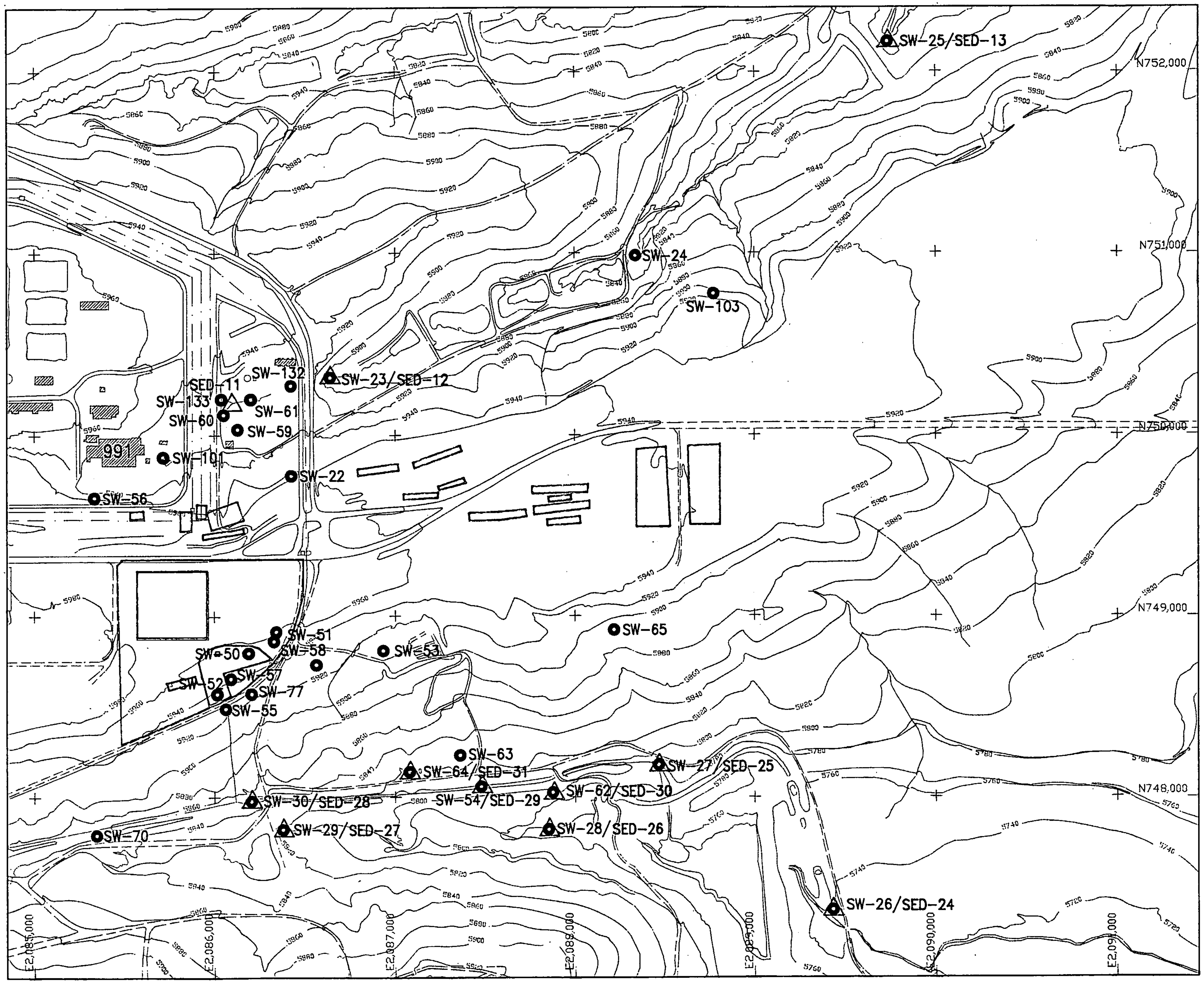

EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITE (IHSS)

SW-23 SURFACE WATER MONITORING STATION

SED-13 SEDIMENT MONITORING STATION

N

Scale: 1" = 600'

0' 300' 600'

CONTOUR INTERVAL = 20'

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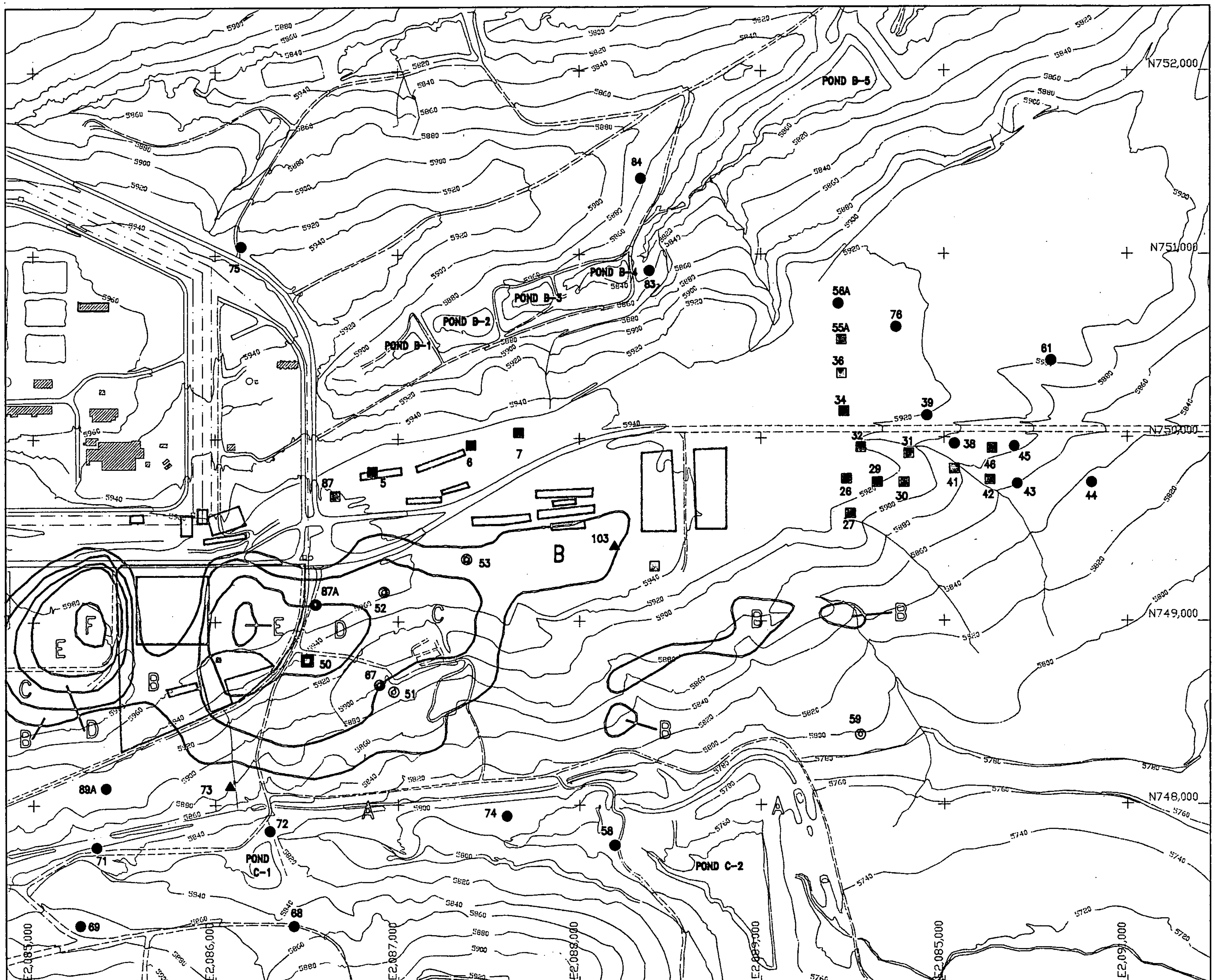
WOMAN CREEK BASIN

FIGURE 2-13

SURFACE WATER AND SEDIMENT MONITORING STATIONS

September 1991

R37M012.CW-083091/600



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITE (IHSS)

● 87A SOIL SAMPLING AND IN SITU MEASUREMENT LOCATION •

• SYMBOL AND COLOR CODE FOR IN SITU SURFACE CONCENTRATION MEASUREMENTS	
	SURFACE •• CONCENTRATION ($\mu Ci/m^2$)
●	<0.006
■	0.006 – 0.050
▲	0.050 – 0.100
◎	0.100 – 0.350
▣	0.350 – 0.840

•• Surface concentration levels of Am-241 were measured using a high purity germanium detector (HPGe) at 100 centimeters AGL.

AERIAL DATA PHOTO PEAK AMERICIUM-241 CONVERSION SCALE	
LETTER LABEL	COUNTS PER SECOND
A	< 50
B	50 – 120
C	120 – 240
D	240 – 600
E	600 – 2,400
F	2,400 – 9,600

N

Scale: 1" = 600'

0' 300' 600'

CONTOUR INTERVAL = 20'

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OPERABLE UNIT NO. 2
SURFACE WATER IN/IRA
WOMAN CREEK BASIN

FIGURE 2-14

SURFACE AND AERIAL AMERICIUM-241 CONCENTRATION DATA FOR THE RFP

Source: An Aerial Radiological Survey of the U.S. DOE's Rocky Flats Plant and Surrounding Area, EGG-10617-1044, May 1990.

September 1991

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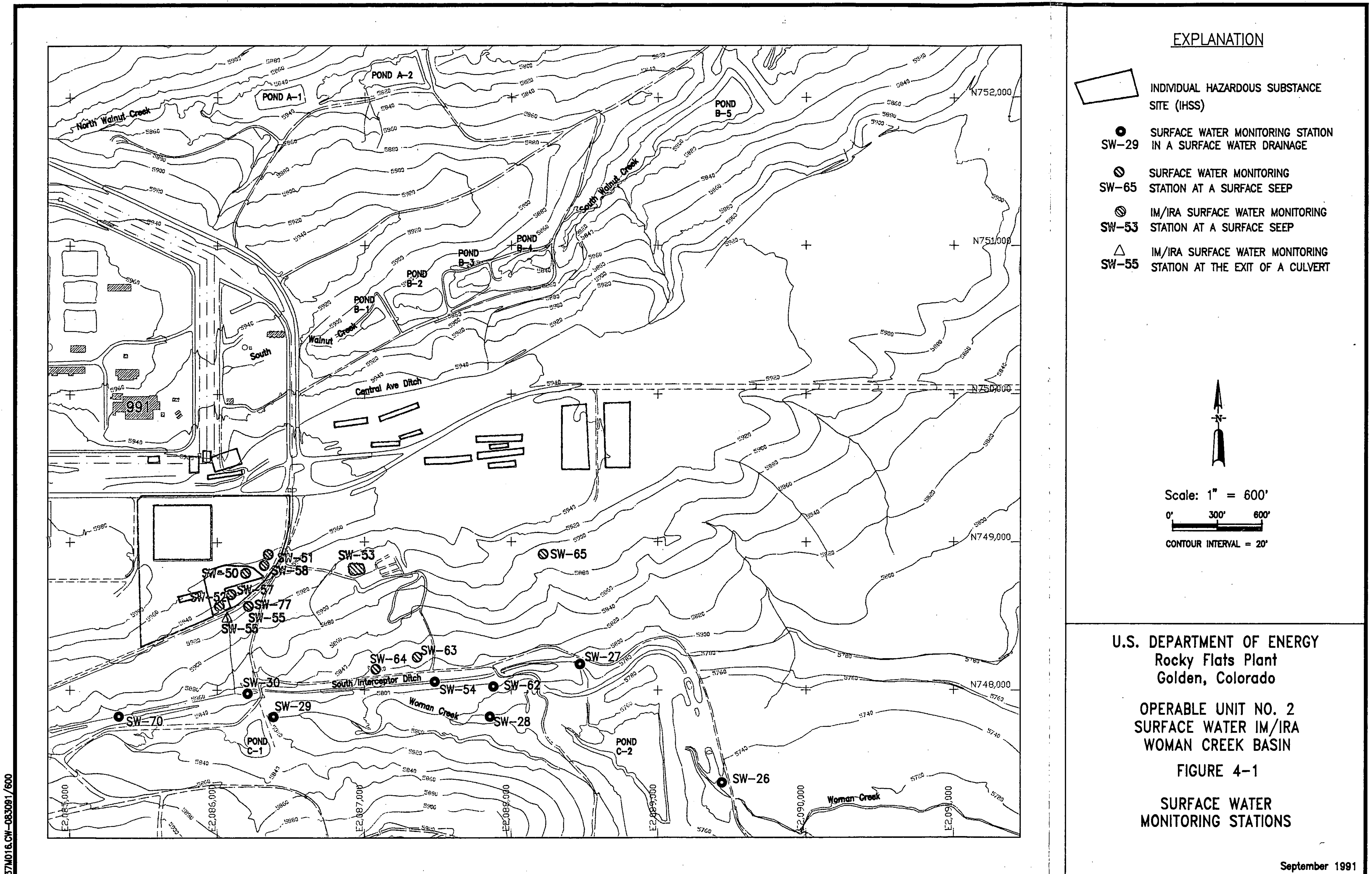

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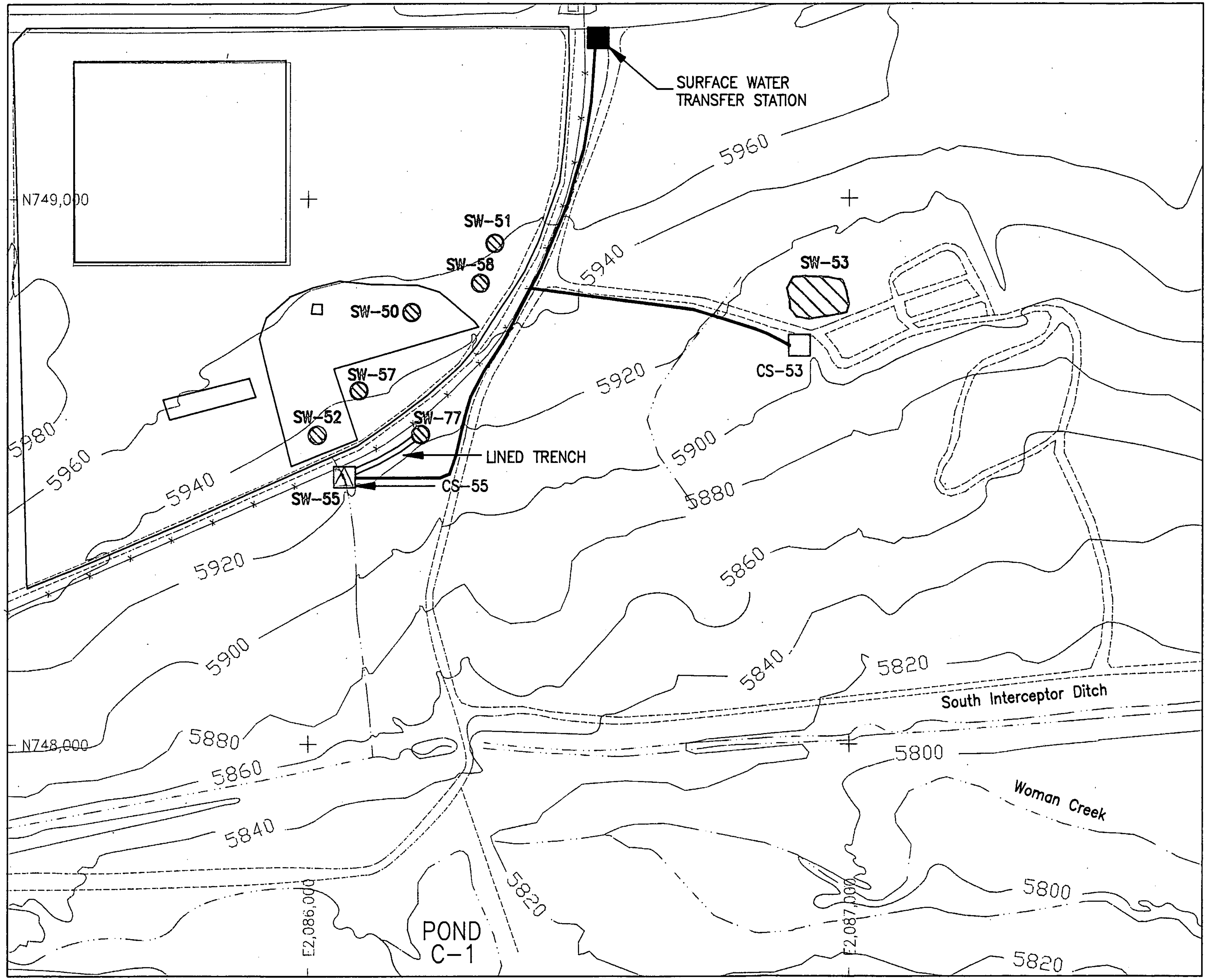
SURFACE WATER IM/IRA
WOMAN CREEK BASIN

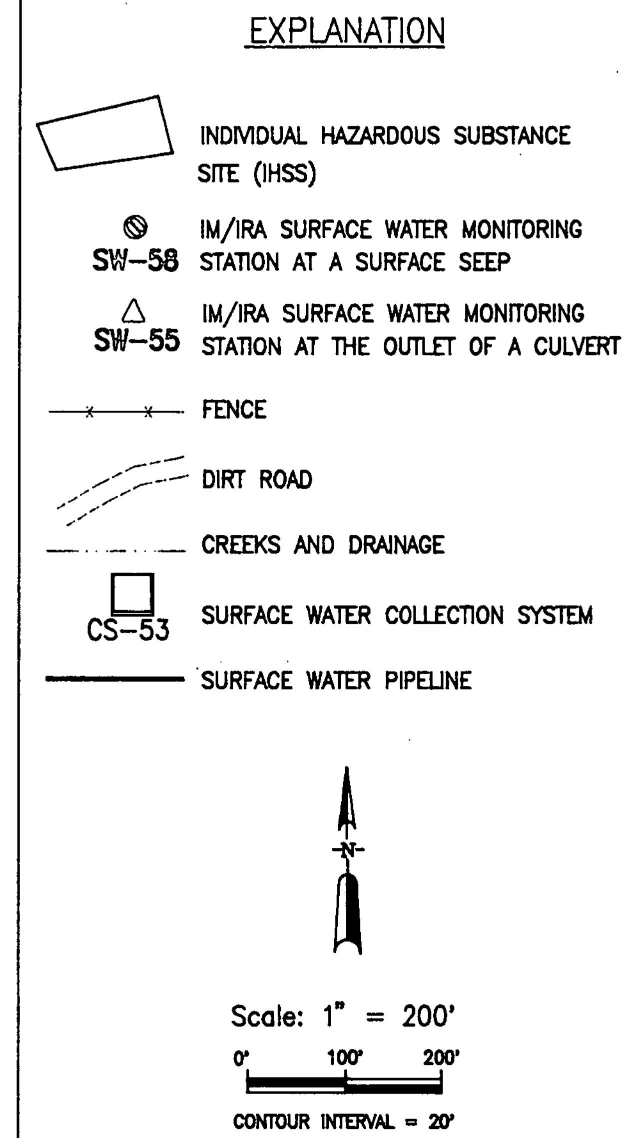
FIGURE 4-1

SURFACE WATER
MONITORING STATIONS

September 1991

R37M016.CW-083091/600





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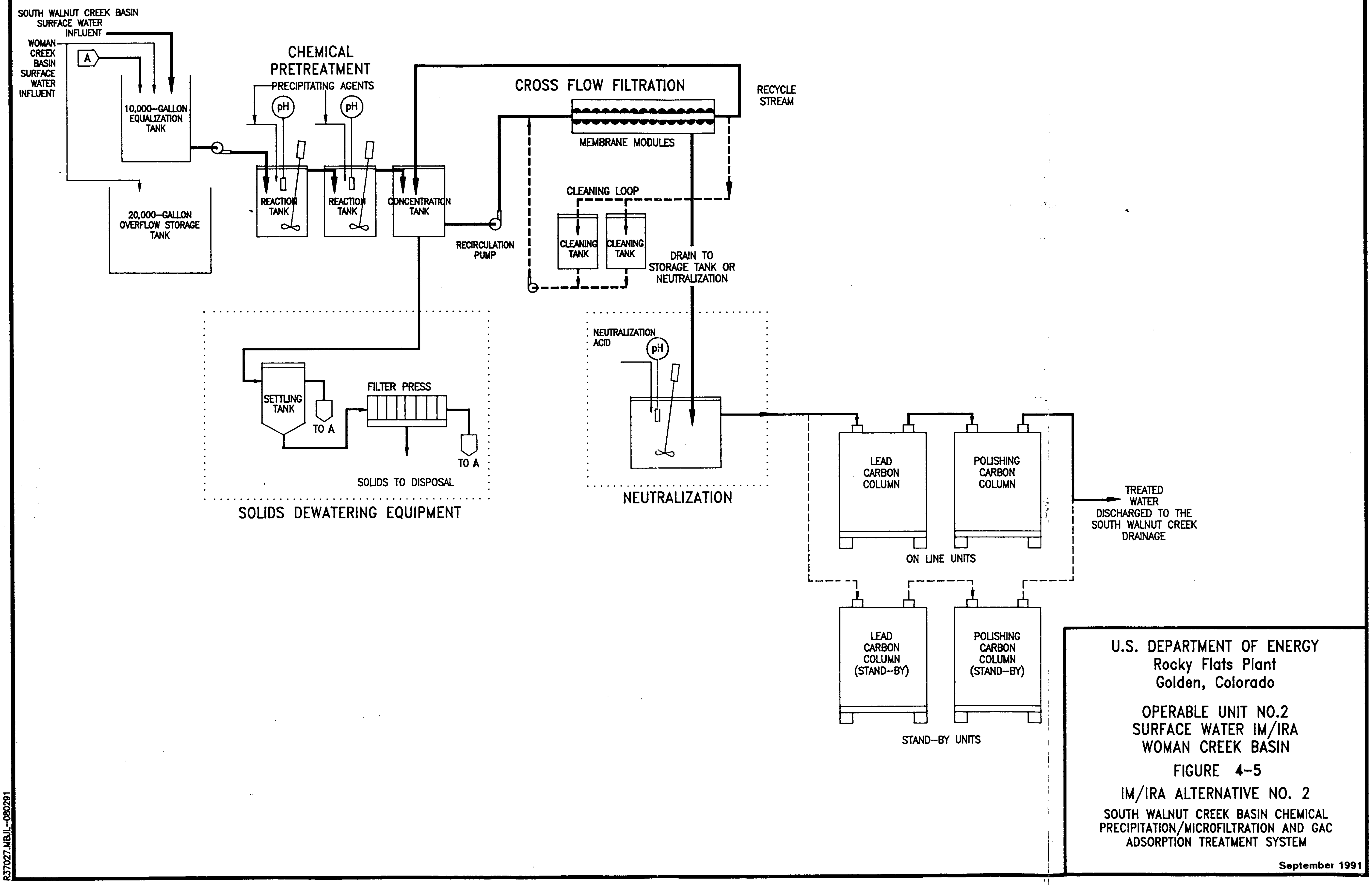
SURFACE WATER IM/IRA
WOMAN CREEK BASIN

FIGURE 4-3

SURFACE WATER
COLLECTION SYSTEMS

September 1991

R37M014.CW-090391/200



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Golden, Colorado

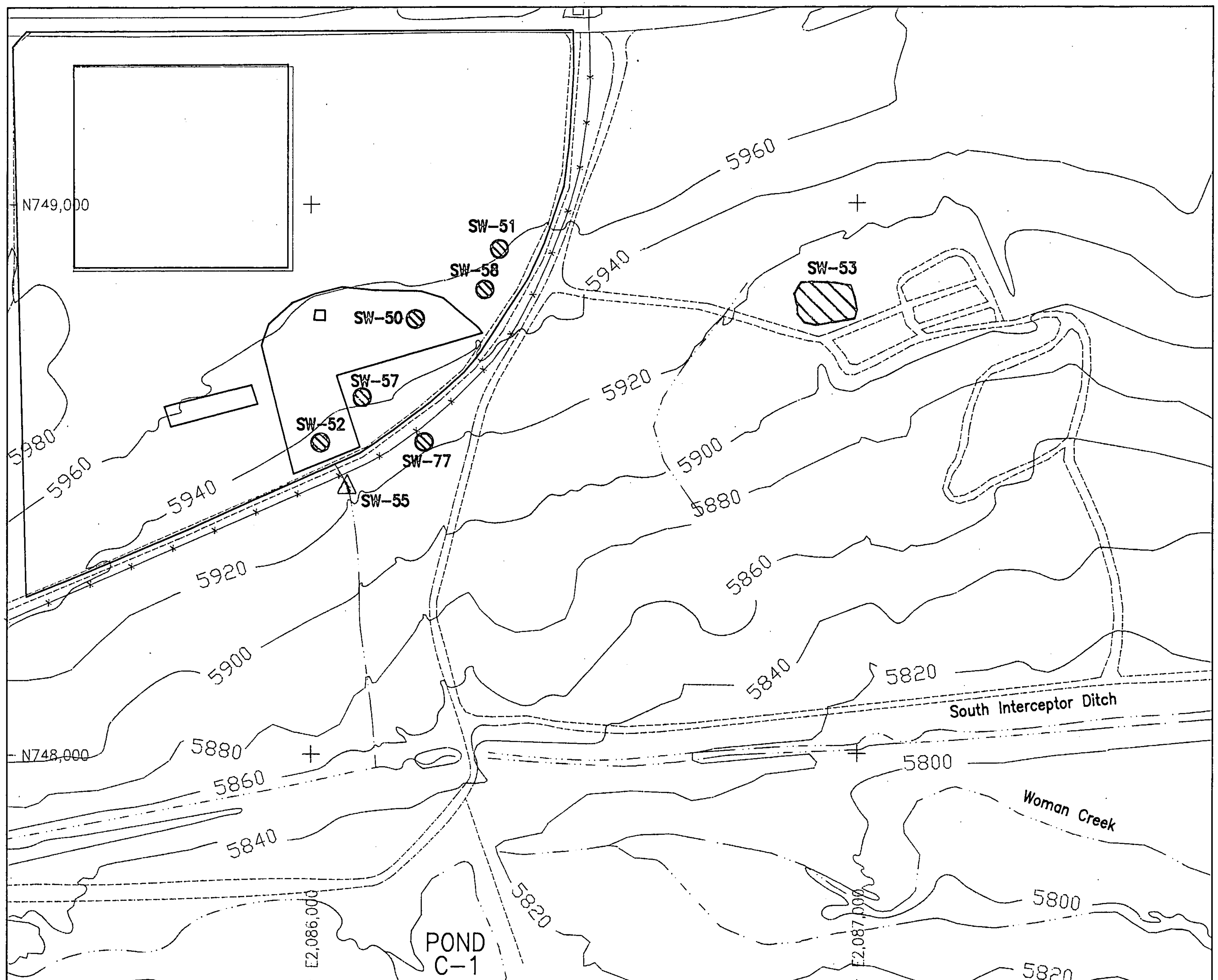
OPERABLE UNIT NO.2
SURFACE WATER IM/IRA
WOMAN CREEK BASIN

FIGURE 4–5

IM/IRA ALTERNATIVE NO. 2

SOUTH WALNUT CREEK BASIN CHEMICAL PRECIPITATION/MICROFILTRATION AND GAC ADSORPTION TREATMENT SYSTEM

September 1991



EXPLANATION

INDIVIDUAL HAZARDOUS SUBSTANCE SITE (IHSS)

SW-58 IM/IRA SURFACE WATER MONITORING STATION AT A SURFACE SEEP

SW-55 IM/IRA SURFACE WATER MONITORING STATION AT THE OUTLET OF A CULVERT

FENCE

DIRT ROAD

CREEKS AND DRAINAGE

N

Scale: 1" = 200'

0' 100' 200'

CONTOUR INTERVAL = 20'

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Golden, Colorado

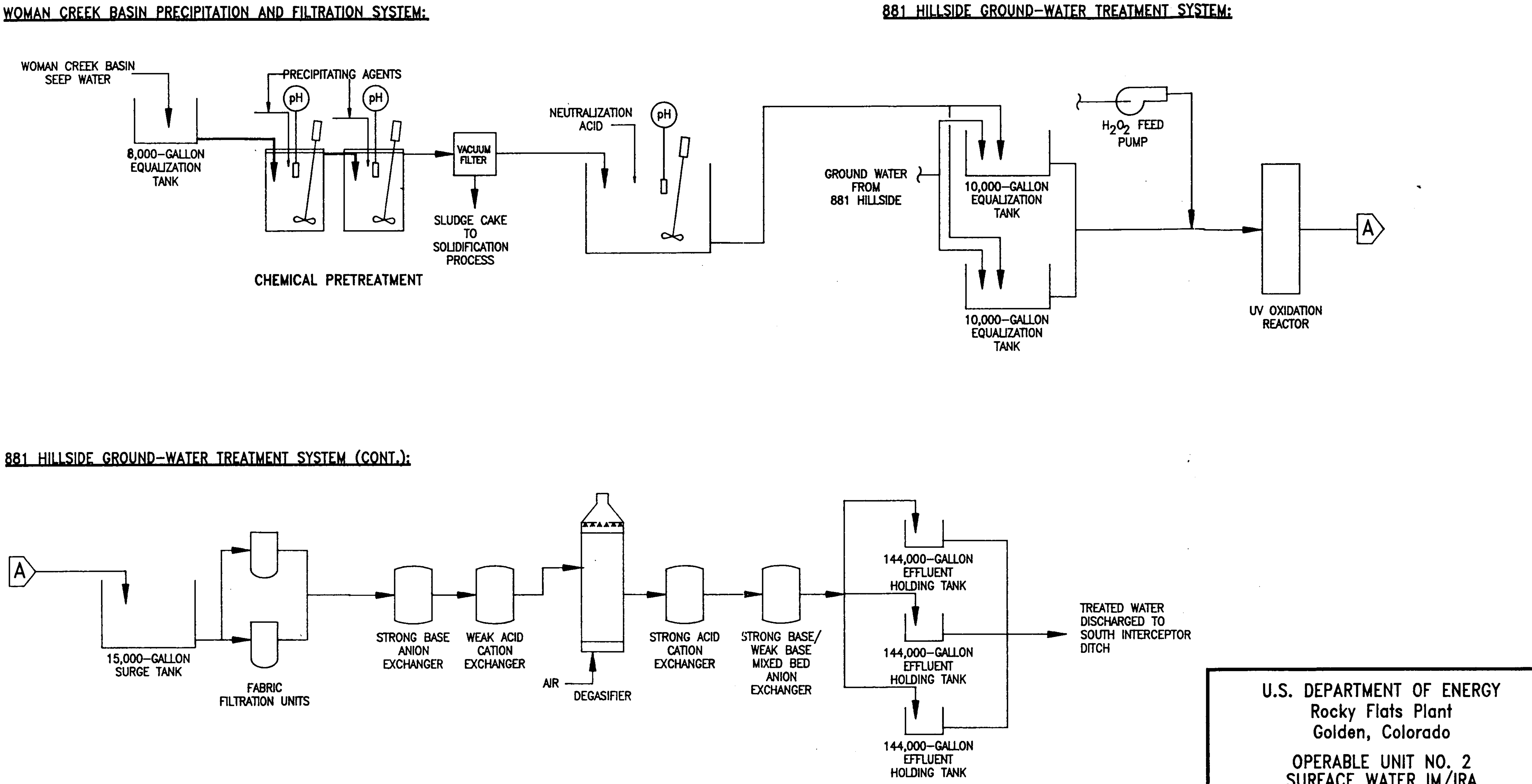
OPERABLE UNIT NO. 2
SURFACE WATER IM/IRA
WOMAN CREEK BASIN

FIGURE 4-2

IM/IRA SURFACE WATER MONITORING STATIONS

September 1991

R37M013.CW-083091/200



U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden, Colorado

OPERABLE UNIT NO. 2
SURFACE WATER IM/IRA
WOMAN CREEK BASIN

FIGURE 4-7

IM/IRA ALTERNATIVE NO. 4

WOMAN CREEK BASIN CHEMICAL PRECIPITATION AND FILTRATION SYSTEM/ 881 HILLSIDE GROUND-WATER TREATMENT SYSTEM (PLANNED)

September 1991

R37038JJJL-080291

TABLE 5-1

COMPARATIVE ANALYSIS OF WOMAN CREEK BASIN SURFACE WATER COLLECTION AND TREATMENT ALTERNATIVES

IM/IRA ALTERNATIVE (ASSUMED PRESENT WORTH)	EFFECTIVENESS	IMPLEMENTABILITY	ENVIRONMENTAL IMPACT (Potential)	COMMENTS
IM/IRA ALTERNATIVE #1:				
• Surface Water Collection by Diversion at the Sources.	• Effective. Collection at the sources will mitigate downgradient transport of contaminated soils by surface seep flows (if occurring). High precipitation-related flows are not addressed during which downgradient contaminant transport may occur.	• Readily implemented. Worker and public health and safety must be ensured through monitoring and dust control measures during construction. Reliable operation and simple O&M.	• Construction – fugitive Pu-contaminated dust, erosion/downgradient contaminant transport, negligible transportation impacts, worker exposure to contaminants. Operation – destruction of < 1,000 sq. ft. of wetlands, negligible transportation impacts (tank truck), minimal worker exposure to contaminants.	
• Surface Water Treatment by the Building 231B GAC Adsorption System and the Building 374 Low-Level Wastewater Treatment System. ($1,255,600)	• Effective. GAC adsorption system will meet VOC ARARs provided acetone, methylene chloride, and vinyl chloride are not present above ARARs. Also, effective for variable flow and VOC loading.	• Readily implemented. All surface water treatment facilities are existing or will be installed by March 1992. Public should strongly favor recycle of treated water. Reliable operation and simple O&M.	• Construction – None. Operation – Worker exposure to treatment chemicals and contaminants, minimal onsite (tank truck) and off-site (disposal) transportation impacts.	• Data suggests vinyl chloride methylene chloride, and acetone will not be present above ARAR. Chemical precipitation/ filtration removes heavy metals.
IM/IRA ALTERNATIVE #2:				
• Surface Water Collection by Diversion at the Sources.	• See Alternative #1.	• See Alternative #1.	• See Alternative #1. No operational transportation impact due to pipeline transport.	
• Surface Water Treatment by the South Walnut Creek Basin Chemical Precipitation/Microfiltration and GAC Adsorption System. ($518,000)	• Effective. Chemical precipitation and microfiltration is likely to meet ARARs for Pu and Am. GAC adsorption system will meet VOC ARARs provided acetone, methylene chloride, and vinyl chloride are not present above ARARs. Also effective for variable flow and VOC loading.	• Readily implemented. All surface water treatment units are existing or will be installed at the RFP by the end of 1991. Reliable operation (based on performance at other installation) and reasonably simple O&M.	• Construction – Negligible impact due to tank truck transport. Operation – worker exposure to treatment system chemicals and contaminants.	• Chemical precipitation/microfiltration removes heavy metals. Data suggests vinyl chloride, methylene chloride, and acetone will not be present above ARAR.
IM/IRA ALTERNATIVE #3:				
• Surface Water Collection by Diversion at the sources	• See Alternative #1.	• See Alternative #1. Tank truck transport of surface water into the PA may pose difficulties.	• See Alternative #1.	
• Surface Water Treatment by the Woman Creek Basin Air Stripping System and the Building 910 Evaporation System. ($1,185,200)	• Effective. Air stripping will meet ARARs for VOCs provided acetone is not above ARAR. Methylene chloride and vinyl chloride, if present, are more readily adsorbed on vapor-phase GAC than liquid-phase GAC. Will not remove semi-volatiles or highly water soluble organics (acetone, butanone). Evaporation is a proven technology.	• Readily implemented. Air stripping is a conventional technology, readily available, but installation and operation more complex than liquid-phase activated carbon. All evaporation system equipment will be installed by the end of 1991. Public should strongly favor recycle of treated water. Evaporation system is reliable and O&M is simple.	• Construction – negligible transportation impact. Operation – worker exposure to contaminants.	• Data suggests that acetone will not be present above ARAR. Air stripping is operationally more complex than liquid-phase GAC. Evaporation removes heavy metals.
IM/IRA ALTERNATIVE #4:				
• Surface Water Collection by Diversion at the Sources.	• See Alternative #1.	• See Alternative #1.	• See Alternative #1. No operational transportation impact due to pipeline transport.	
• Surface Water Treatment by the Woman Creek Basin Chemical Precipitation/Filtration Treatment System and the 881 Hillside Ground-Water Treatment Facility. ($1,058,300)	• Effective. Chemical Precipitation/ Filtration is likely to meet ARARs for Pu and Am. UV peroxide oxidation is less proven than GAC adsorption or air stripping. Effective operation may be difficult with variable VOC loading.	• Readily implemented. Chemical precipitation/filtration is a conventional technology requiring only standard equipment and materials. Reliable operation and simple O&M. 881 Hillside Ground-Water Treatment System will be installed by March 1992. Treatability studies may be required.	• Construction – Negligible transportation impact. Operation – worker exposure to treatment system chemicals and contaminants, negligible transportation impact.	• Chemical precipitation/filtration and ion exchange remove heavy metals. UV peroxide oxidation destroys VOCs.